

# MANAGERIAL CONTROL

INSTRUMENTS AND METHODS IN INDUSTRY

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By

JOHN G. GLOVER, M.C.S., Ph.D.

ASSOCIATE PROFESSOR OF MANAGEMENT, SCHOOL OF COMMERCE,  
ACCOUNTS AND FINANCE, NEW YORK UNIVERSITY

COLEMAN L. MAZE, A.M., M.C.S.

PROFESSOR OF MANAGEMENT, SCHOOL OF COMMERCE,  
ACCOUNTS AND FINANCE, NEW YORK UNIVERSITY



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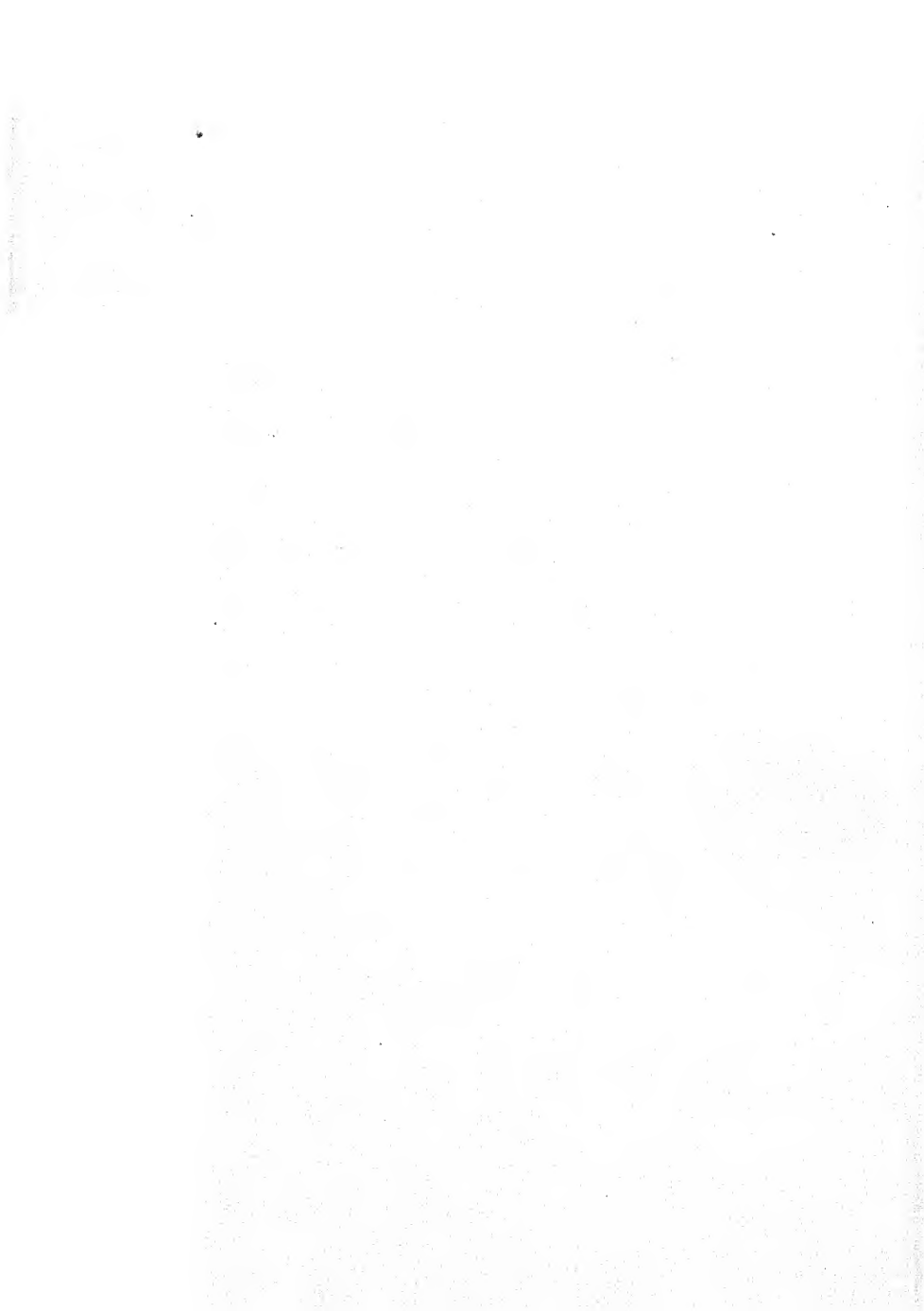
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THIS BOOK IS DEDICATED  
TO  
DR. GEORGE ROWLAND COLLINS  
ASSOCIATE DEAN  
OF  
THE SCHOOL OF COMMERCE, ACCOUNTS AND FINANCE  
NEW YORK UNIVERSITY



## PREFACE

An all important question always before Management is, "How can future profit margins be maintained without relative increases in selling prices, when social and economic changes are not only forcing increases in current operating costs but are also producing such fundamental changes in the basic structure of business that both fixed and variable costs of future operations must inevitably increase?" Furthermore, if future business operations are to be maintained at profit making levels, it is essential that all activities of business must be more effectively conducted. Management believes that social changes, restrictive legislation, and steadily increasing rates of taxation are but symptoms of far reaching and permanent changes which are in the making.

It knows that current changes have seriously handicapped operations and endangered profit margins. Management realizes, too, that it no longer possesses the freedom it formerly had to adjust wages, working hours, and competitive practices in such a way as to prevent excessive shrinkages in profits.

The question is a natural result of those ever-occurring changes which tend to outlaw or outmode previously useful methods and instruments of control and which, because of their permanency, make new and better managerial policies and methods always necessary.

It is believed that the answer to the question will be found in better balance in organization, increased individual effectiveness, elimination of waste, more effective planning through research, dependable and inclusive standards and records, and the reduction of costs through new and improved methods and instruments of managerial control.

Therefore, this book, predicated upon that belief, is designed to supply at least a partial answer to the question. It emphasizes the necessity for setting standards and measuring actual

accomplishment as a basis for control; it endeavors to point out the methods for determining causes for variations between planned and actual accomplishment, and it indicates the more important causes of such variations as well as their underlying reasons. It also describes those instruments and methods which are being used successfully in bringing variations under control. The importance of cost reduction work is stressed, and the methods for organizing and conducting such work effectively are given. The fact that the material included, deals with all phases of business activity and that it is logically and clearly presented, should make it extremely valuable to those executives who are aware of the need for new and improved control devices. Sufficient examples and illustrations are included to make the text matter both useful and understandable.

The authors are deeply indebted to Professor William B. Cornell, Chairman of the Department of Business Management, School of Commerce, Accounts and Finance of New York University, for his valuable guidance and expert advice during the preparation of the manuscript. To Dean George R. Collins and Professor Hugh E. Agnew of New York University the authors express their sincere appreciation for their constructive suggestions in connection with marketing and advertising costs. They are also grateful to Professor Theodore Lang for his expert opinions and suggestions in the field of cost and general accounting. To Mr. David Moffat Myers, Consulting Engineer, the authors are especially indebted for his valuable advice in the field of power plant operation and costs. To many business executives and professional accountants, including Mr. Archibald M. Richmond, the authors are indebted for their assistance in the preparation of exhibits and for permission to reprint forms and drawings.

JOHN G. GLOVER

COLEMAN L. MAZE

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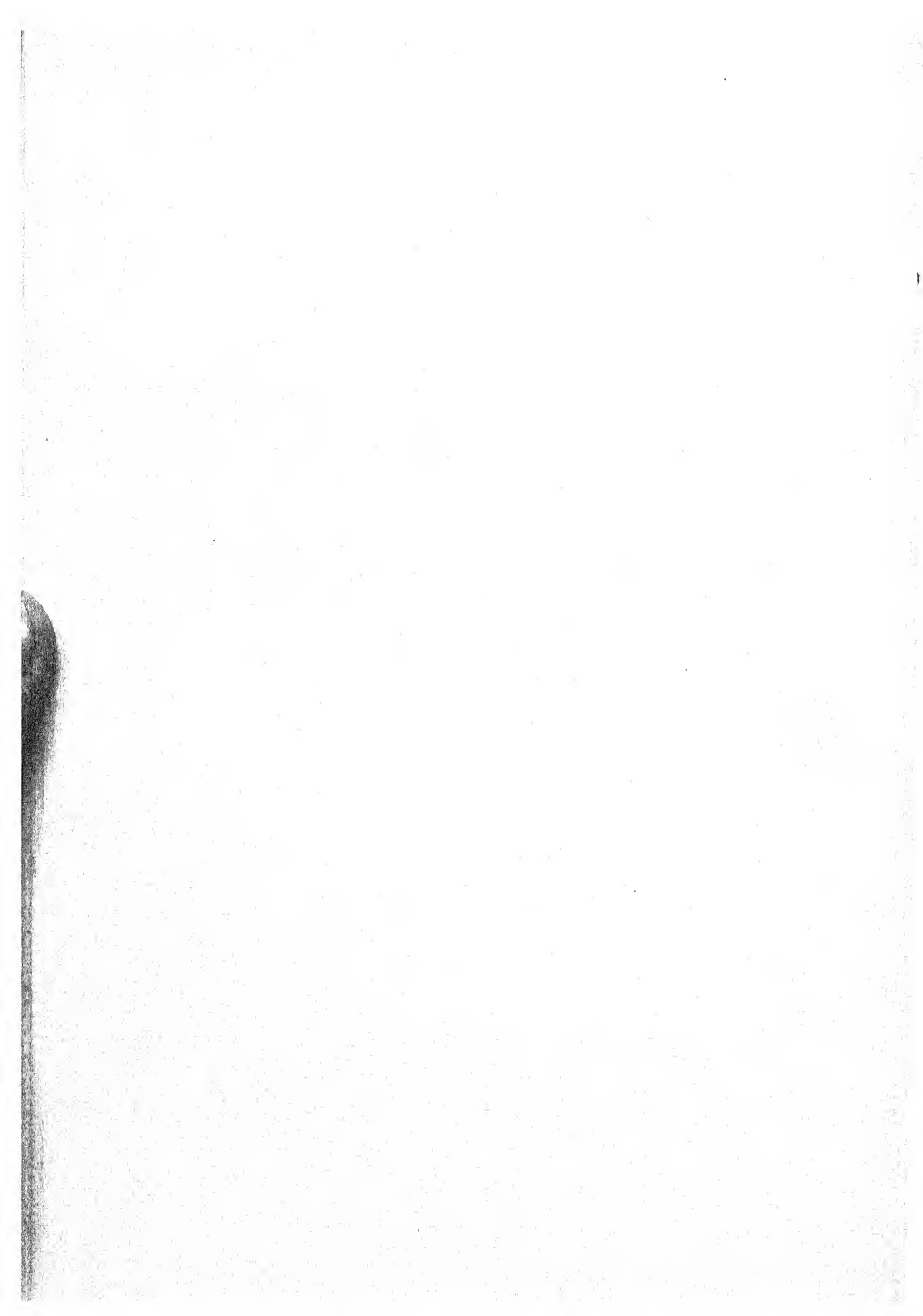
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# **MANAGERIAL CONTROL**



## CHAPTER 1

### RESEARCH IN BUSINESS

**Management and Research.**—A well-known authority<sup>1</sup> stated that research is finding out what we are going to do when we cannot continue doing what we are now doing. This idea conveys impressively the need for research in business today. We know that our methods and practices are imperfect in many ways, and we know that much of the service rendered to consumers is not quite satisfactory and that production costs and prices of commodities are still too high. We know, moreover, that business has not assumed its full measure of social responsibility. Political and legislative trends during the past few years are positive indications that we cannot longer continue in the same manner as in the past.

Management directs and controls through the application of a definite body of rules and principles which are founded on the sciences of Economics, Sociology, and Psychology. Science and invention paves the way for management to develop new products and services along with the materials, machinery, tools, and technical methods to be used in their creation and distribution. From these materials of management must be drawn the policies and principles needed by executives in the direction, operation, and coordination of those activities engaged in the creation and distribution of such products and services.

Just as the scientist and inventor must do research to find new products, materials, and appliances, so must management perform research to find new policies and principles, and new applications of those already known to use in their production and distribution. The fundamental supply of business information can wane just as surely as our supply of natural re-

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<sup>1</sup> Dr. Charles S. Kettering, Director of Research, General Motors Corporation.

sources is being depleted and wasted. If we, as a nation, permit this condition to arise, we thereby eliminate ourselves from the competitive struggle and usher in the decline of our present industrial supremacy.

Thus, as this well-known authority says, we must develop research to find out what can be done to aid us in removing our present shortcomings and what aid is necessary in replenishing and adding to our store of fundamental knowledge along with information that we can use for future development.

There are many millions of available workers in the nation today for whom there are no jobs in private industry. Moreover, the millions who are employed in private industry are by no means supplied with the quantity and variety of goods that can be consumed by them. Clearly, here is a research problem of tremendous scope and significance. It cannot be ignored by business men and passed off as the responsibility of the government or some other agency. Business men, therefore, must face the issue squarely as one of their own making and one which they are responsible for solving.

Again, the complaint is heard that our industrial and commercial establishments are overexpanded. This means, they have a greater productive capacity than the maximum demand can or would consume. The truth is, that instead of this being the case, lack of research leaves us with too few new products and inability to provide widespread employment at profitable rates so that purchasing power might be increased to consume more existing products and at the same time create a reservoir of buying power that would be available for us as new products come into existence.

The handwriting is on the wall for those business concerns, large and small, who fail to recognize the importance of research to their business and who fail to promote and encourage it. Imitation never leads, it always follows, and if the present keenness in competition increases in the future as is expected, the lag between the leaders and those who follow will become so great that the imitators will find it difficult to continue their business existence much less to continue it at a profit.

**Definition of Research.**—To systematically search, investigate, experiment, and examine the known so as to discover the unknown.

Scientific Business Research concerns itself with the systematic accumulation of business data and information, the verification and analysis of these data and information so as to discover new facts, principles, laws, and policies which will further the development of the business objective. The results of business research will be portrayed in all phases of business operation and the commodities produced or services rendered, by that concern which carries on scientific research. Thus, research becomes one of the important tools utilized by management to determine ways and means of reaching the ideals set by the business objective. Costs and cost reduction are fertile fields for research and most of our progressive organizations are extensively engaged in this particular phase.

Research used as a tool of management should aid in the following ways:

1. To reduce the cost of the commodities produced or the services rendered.
2. To reduce the cost of selling the commodities.
3. To reduce the cost of manufacturing operations.
4. To develop new methods of production.
5. To develop new devices for manufacturing operations.
6. To develop new products.
7. To increase the sales appeal of products.
8. To increase the effectiveness of advertising.
9. To increase the utility of the product.
10. To determine and establish better policies.
11. To increase the volume of business.
12. To aid in better administration of the concern.

**Organization for Research.**—Technical research is organized frequently as one of the functions of engineering. The head of the department of engineering, usually a chief engineer, assumes responsibility for the direction and conduct of the research function along with his other responsibilities. In a number of the larger manufacturing concerns, research is or-

ganized as a separate activity under the direction of a research director or a research committee. In a few cases, the research director is in active charge of the function and a research committee consisting of three or five major executives act as a control unit over the research. The director, or chief of research, plans the work, prepares the budget estimates and recommends changes or additions to work and staff. No work is undertaken without the approval of the committee, and it is kept currently informed of the progress and cost of each research project. In many companies the technical director is supervised directly by the general manager or the president of the concern. The committee plan appears to be more popular because of the better coordination between research and operations which may be established and maintained under this plan.

No such clearly defined or uniform organization practice is found in connection with managerial research (or company research other than technical). In fact, there are but few cases on record where organized research along broad lines is carried on for the benefit of company management. In comparatively few concerns there are planning or production control divisions which do some research work in connection with production and production methods, and in a few cases this work includes a wide range of subjects related to production and operations control. Market research divisions are found in a few cases of the larger concerns, although in relatively few instances is the research division organized to consider all the problems arising in connection with product distribution. The General Motors Company Research Division is regarded as one of the most complete in this field.

The comptroller, the personnel director, the office manager, and other department heads often do a minor amount of research work in their respective fields. It is seldom well organized, planned, or correlated with other research work. The statistical division of a large company carries on economic and general business research and frequently aids in market and other research, but they are not qualified as a rule to delve into many other problems that concern management. Such agencies as cost reduction units, methods and results divisions, and

cost control divisions are usually created for limited purposes and while they accomplish a great deal in their limited field, they cannot be expected to carry on extensive research work into the related fields. The benefits they produce cannot always be retained nor extended because further study and investigation is not carried on.

In consideration of the great need for organized and correlated research work in manufacturing and commercial concerns, it would appear profitable for many concerns to organize a company-wide research unit; to study all phases of managerial problems and to conduct investigations and surveys into all phases of managerial activity in an effort to prevent waste and increase efficiency. Such a unit could take over a great deal of the work now being performed by various other units, correlate it and extend it as far as profitable. In addition, this work could be more closely and effectively integrated with the technical research work, which would aid greatly in enabling management to plan a program of company operations from product development and sales forecasts up to the point of delivery of finished product to customers and to plan finances and accounting that would be interdependent and so well correlated that better balance between all factors of the business could be maintained with the achievement of greater economy.

**The Cost of Research.**—The most often repeated reason for failure to sponsor research in a business is that it is too costly, or the results and outcomes are much too uncertain. There are but few things of value which can be procured without cost and there are but few things that are beyond the realm of research. One wonders why cost should be a factor, especially in the so-called progressive business concerns where management is a dominant element.

It is true that research is costly, but in terms of values received, it is usually one of the profitable activities sponsored by business. Many research studies and experiments fail even though they cost considerable money. Usually failures are regarded as losses but this is not necessarily true. Research that produces negative results may have definite value although

it is not as easily measurable as those that are positive. The value of research should be measured against results of that research although it may extend over a period of years. However, the costs of all research projects should be carefully kept, so that they can be analyzed by management. It is possible through careful planning for research and proper organization for and of each project to keep the costs consistent with the value of the work, but it is not possible to eliminate the uncertainty of results for any particular project. However, in general, it is sometimes true that each seeming failure gives birth to new ways and means for solving the problem under consideration. It should be pointed out that valuable by-products often come from a research that does not reach its objective. An attempt to make synthetic surgical sutures was a failure, but an excellent tennis racquet string was developed as a by-product.

Many concerns prepare comprehensive cost estimates of research work and make subdivisions of costs by specific projects. Funds and time are budgeted against each project and if it is not completed by the estimated expiration date, or if the funds are used up before the research is finished, a request must be made by the director for additional time and funds. This request is usually accompanied by a statement of progress, and an estimate of additional time and funds required and a prognosis of benefits expected from completion of the project. In some cases the cost of research labor and materials is accumulated by research projects and the expense is applied on a percentage of labor hours. In other concerns only labor costs are calculated while in others the total cost of operating the research department is prorated over the completed projects for each cost period on the basis of estimated benefits to be derived from each project. It appears to be a somewhat widespread practice to allocate the cost of each project against the benefits expected from it.

The Policy Holders' Service Bureau of the Metropolitan Life Insurance Company made a study of the practice in some seventy-five business concerns and on the basis of those reporting, declared that careful attention to costs in some detail



and efforts to compare costs of research with benefits derived by projects was in general practice.

Most of these concerns prepare a research budget at the beginning of each budget period in which is shown estimates of total cost by main divisions of research activity and detailed cost estimates by projects. In the majority of these cases the estimates include completion time and cost of new apparatus needed. A summary indicates the nature and scope of each project, the need for it, and what it proposes to accomplish and the commercial value of the accomplishment, in so far as it can be foreseen at that time.

One of the important reasons for high costs of research is failure on the part of management to prevent the research department from using up its time in aiding other departments on problems that should not be handled by research workers. There is, of course, great need for close cooperation between operating men and research workers, but all work must be scheduled and definitely assigned by management.

**The Field of Business Research.**—The objective of this particular discussion is not to delineate in detail the individual subject fields of business in which research may be carried on, but to emphasize the fact that in all phases of business the scientific method is essential to successful performance. By liberal interpretation of terms, business research might be regarded as that agency engaged in gathering, recording, tabulating, arranging, analyzing, and presenting facts relating to the technical and managerial operation of an enterprise.

In the field of technical operations, research must concern itself with:

1. PARTS AND PRODUCTS

- (a) Their design, development, modification, interchangeability, use, maintenance, standardization, fabrication, testing, classification, substitution, etc.

2. MATERIALS

- (a) Development, substitution, standardization, testing, use, specification, etc.

- (b) Development of new applications of products.
- (c) Development of by-products.

### 3. MACHINERY, EQUIPMENT AND TOOLS

- (a) Design, development, modification, interchangeability, substitution, testing, use, maintenance, construction, installation, operation, etc.

### 4. TECHNICAL METHODS

- (a) Development, adaptation, improvement, test, standardization, etc.

It is not necessary to provide illustrations of the many benefits to be gained through the conduct of research in these subjects. Our present economic life in itself is such an illustration.

**Non-Technical or Management Research.**—The constant challenge to business executives is to discover or create new and better methods with which to meet the swiftly changing economic and social conditions at home and abroad and to adjust to those internal situations and conditions which tend to reduce operating economy and lower the competitive resistance of the business. Managers must resort to research in order to find sound solutions to the many problems that press upon them each day. Executives know that too much is involved in each case to warrant guessing at the proper solution. They are not always aware, however, that past failure to do research is the reason for today's pressing problem, and they fail to see the many possibilities for research activity in connection with the operation and administration of the business. In other words, they are all too ready to admit that they have found the one best way.

The subject fields of business in which research might be done profitably are so broad that it would not be possible to list and describe each of them. Many of the fields are so broad that even textbooks on an individual subject fail to bring all of the phases of activity embodied within it. The following illustration will give a general idea of a part of the fact-finding work that should be done before introducing a new product. The answers to several times the number of questions here listed

must be found and kept up to date if new products are to survive in the competitive field.

**Research and Costs.**—Today, competition is largely a matter of price and service. Underhand methods, unfair agreements and practices, and unusual advantages of size, and a myriad of other conditions and factors which lead to unethical, sometimes illegal, and always destructive competitive practices are coming rapidly to be regarded as relics of a past era. Competition is believed by many to be on the decline, but it can still be said that the enterprise that does not capitalize all of its resources for advancement will decline much more rapidly than competition. The public demands better goods and services, higher and more uniform quality at lower prices. The growing tendency toward wage legislation and stricter enforcement of quality standards by legal agencies and the public, together with the outlawing of unfair competition (Robinson-Patman Act), have removed the most often used methods of cutting costs as a basis for price reductions. Thus, it is becoming increasingly necessary for business men to focus their attention on ways of reducing costs and maintaining quality of product and service without cutting wages or offering inferior substitutes. Research has already demonstrated that it is an effective tool for cost reduction and that its use for this purpose must be expanded. There are many causes of waste in the use of labor and consequently many factors that make labor costs excessive, other than the rate of wages or the total wage paid. Moreover, many other cost elements are affected by the labor policies adopted by a company. For example, research indicates that it is almost universal practice to increase the rate of hiring as well as the rate of accession of labor just before a period of declining business sets in. More time and money are spent in training workers who will be laid off within a short period. Promotions of junior executives to higher positions are made more rapidly at this time, even though most of them will be demoted or laid off. In the field of materials costs as well as in selling, administrative and financial costs, these same phenomena are to be observed. Heavy purchases of materials are





made just before price declines set in; plant expansion takes place just before volume falls off; new capital is usually acquired to finance those projects just before its use will become unnecessary. In a wide variety of ways, it is possible to observe unnecessary increases in operating and administrative costs due to a lack of management research.

The conviction that an organized program of management research can play such an important part in reducing and controlling costs, is the fundamental reason for this text. While the authors have not attempted to indicate the technique used in discussing each phase of business costs, the reader will have no difficulty in observing that the conclusions presented have been derived through research. The causes of waste and high costs pointed out in subsequent chapters, as well as the suggested plans, policies, and methods for their control and reduction have been developed through the practical application of research technique in those progressive business concerns from which these recommendations and conclusions have been taken.

**Reasons for Poor Executive Judgment.**—It is unquestionably true that poor executive judgment is a major cause for managerial incompetency. On the assumption that this is true, it is not difficult to develop the more important reasons for poor executive judgment. For the most part, the reasons are self-evident. The lack of training in the particular field, lack of familiarity with the problems requiring solution, failure to consider all aspects of the problem before rendering decisions, the announcement of plans or policies without proper pre-planning, and other similar reasons are likely to be responsible for poor executive judgments.

Wise judgments are possible only when the executive withholds decision until the problem is clearly outlined, the facts are in his possession, and he has had an opportunity to analyze and study the facts and draw logical or provable conclusions from them. The average business manager is fully aware of this fact, but he seldom realizes that his mental approach to the formation of judgments is haphazard and erratic. The far-reaching effects of improper business judgments and the

importance of accuracy of opinions and decisions have prompted business men to seek the facts before passing judgment. Properly organized lines of thought and procedure in surveying and studying the various business problems with which all executives must deal are essential.

**The Research Attitude.**—Research undertaken to prove an already formed opinion cannot be too vigorously condemned. To find the truth, whether or not it corresponds to previous assumptions or shows those assumptions to be incorrect, should be the objective of research. It is much easier to perform the research work in such a way that the findings will verify preconceived opinions or conclusions than it is to proceed with an unbiased mind in the search for truth. Therefore, unless the scientific attitude is held always by the research worker, the results of the work will be of little value and may on the other hand be extremely dangerous. Business decisions, plans, and policies which arise as results of research findings may determine the ultimate success or failure of the project or enterprise. Individual desires or convictions, personal pride or prejudice, and all other matters not a part of truth must be discarded before the research starts.

**The Phases of Analysis.**—There are six fundamental phases in the analysis of all business problems regardless of their nature or complexity. They are as follows:

1. Recognition and statement of the problem.
2. An analytical study to determine all phases of the problem.
3. Determination of all facts which have any bearing on the problem.
4. Gather all data involved.
5. Analyze the factual data.
6. Establish conclusions based on the analysis.

1. **RECOGNITION AND STATEMENT OF THE PROBLEM.** The first step is to recognize that there is a problem and to so clearly state it that a definite plan of action may be set forth which will embody the entire problem. If there are two or more problems involved, they should be segregated in order that the limits and

nature of each may be clearly defined. The gathering of data should not start until the problem has been clearly and carefully stated.

2. ANALYTICAL STUDY OF THE PROBLEM. A thorough analytical study should be made of the problem to determine its various phases and their relationship to the whole. Each individual phase should be further examined to reveal its constituent aspects and their bearing on the problem. With the problem now split into its integral parts the worker has a knowledge of the nature, class, and type of facts which must be procured in order to solve that problem. *Analysis.* The term analysis is rarely understood in its fullest sense by most business men, although many use the term in connection with their business operations. Scientific analysis as it is applied to business problems means the determination of the fundamental elements or factors, their nature, characteristics and quantity, the careful study of these factors and their correlation.

3. DETERMINATION OF FACTS. From the critical examination of the problem and its various phases the researcher must determine all facts which have any bearing whatsoever on the problem. Even the so-called relatively unimportant facts must be noted for later study.

All superficial, inaccurate, inadequate, and improper data must be ignored, not only because they consume time and energy to collect and examine, but because the most important characteristics of all data used for research purposes are accuracy and reliability. A thorough survey and investigation should be made to determine, first, the sources of primary and secondary data; second, the availability of the data and, third, means and ways of collecting the data. To collect the data without first being positive that they are accurate and dependable would be of no value but might be of considerable harm. To verify these considerations it may be necessary to make a sampling test of the information. It is better to take this precaution beforehand than to proceed with the collection of the data on the assumption that they are reliable and accurate in all respects.



4. **GROUPING OF FACTS.** The analysis of the facts may be greatly facilitated by so collecting and organizing them that they fall into logical groupings based upon their relations to the several phases of the problem. Care and attention should be given to the method of arrangement of the data as they are collected to facilitate the analysis and to make the results of the greatest use and accuracy. Distortion of the unit, lack of consistency in use of terminology, unit, average, etc., may to a great extent neutralize the reliability of the data. Another point to be considered in the collection and recording of the facts is that the person analyzing the data may not be the same person as the one who collects them. It is necessary, therefore, that the facts collected and recorded be set forth in a manner that will be clear and understandable to any person making the analysis. This refers to the unit, the averages, periods under comparison, allowances and weights, modifying factors and other external considerations which may affect the facts.

The technique of recording and classifying the facts as they are discovered cannot be treated here. It will likely include various methods, depending upon the character of the facts and data investigated and recorded. For example, if the facts relate to a system or procedure, the process chart, narrative form, or symbol method may be employed. If the facts discovered are subject to statistical tabulation, the recording may be done by the statistical tabular method. Where both figures and historical data are discovered, a combination of two methods may be used together with graphic illustration and recording. The primary consideration is to be certain that the technique or method will assist in obtaining complete records, yield to quick and accurate classification and verification and facilitate the analysis of the facts which must follow their collection and recording. It is important to so identify, classify, and preserve all working papers that a recheck can be readily made if desired.

5. **ANALYSIS OF THE FACTS.** It is improbable that when the facts have been collected and recorded, the conclusion will be obvious. It may happen occasionally that through the cor-

rect method of recording facts, the conclusion becomes obvious to the analyst or may be reached with little effort. As a rule, a very careful and thorough analysis of the facts must be made before conclusions can be drawn. Not every individual in the organization is capable of analyzing data and drawing the correct inferences and conclusions. Relationships expressed by figures and the interpretation of statistics demand skill, training and familiarity with the subjects covered by the data. Therefore, great care must be used in selecting the individual best qualified to make the analysis.

In the process of analyzing the facts, difficulties may be experienced owing to the arrangement, classification, tabulation, or other factors in the original recording of the data. Oftentimes it is desirable to recast the facts, to rearrange the statistical tabulations, to change the units, classes or bases, and in various ways to reshape the facts to make them subject to a more thorough, complete, or accurate analysis. This may require additional time and involve considerable work, but, if the truth is being sought and it is desired to establish a sound basis for deductions and conclusions, this work becomes a necessity, regardless of the time or effort required to do it.

Additional information concerning the technique of analyzing the facts could be profitably set forth. However, if the analyst is thoroughly familiar with the industry, the problems under consideration, the data at hand, and is assured that the data are complete and accurate, a thorough analysis is possible, and all inferences and conclusions leading to a solution may be made.

6. ESTABLISH CONCLUSIONS BASED ON THE ANALYSIS. The conclusions drawn from the interpretation of the data should be developed according to the elements of the problem. It is a dangerous step to attempt to formulate a conclusion covering an entire problem until detailed conclusions covering each element of the problem have been reached.

Hasty or ill-advised conclusions are the result of failure to build them step by step in a systematic and careful manner. By recording the inferences and deductions or interpretation of

facts relating to each element of the problem, and by making a new recording of the conclusions relating to the separate elements, the conclusions relating to the problem as a whole may be reached. Predetermined opinions, prejudice, or preplanned results should be given no weight whatever in arriving at conclusions. The analyst must proceed to each conclusion with an unbiased mind, free from influences of personal opinion or prejudice, and without regard to his own wishes or desires. If the elements previously considered do not bear upon the conclusions reached, they should, of course, be given no consideration and not be permitted to affect the logic or correctness of the thinking processes used in arriving at the conclusion. The conclusions drawn from the various analyses form the basis for the determination of policies designed to correct maladjustment, error, or unsatisfactory conditions in the organization. In view of the importance of policy change to the possible success of the business, it is inadvisable to accept the conclusions reached as the basis for determination or change of policies until they have been tested and verified.

*Verification of Conclusions.* Most times conclusions may at least be partially verified, or their accuracy established. Where it is not possible to obtain a measure or proof of the conclusions, the analysis should be repeated by another, if the matter is of sufficient importance to the concern. In one manufacturing company, an analysis was made of the wage situation in the factory for the purpose of determining the advisability or profit to the company of adopting a different wage system. The facts were gathered and analyzed, and the conclusion reached that the change would be profitable. However, before the adoption of the new wage payment plan throughout the factory, a single department was operated under this new method of payment, and the results of this experiment were watched with great care. When the operation of the plan was observed and studied for a time in this department and found to be satisfactory, it was felt that the conclusion was sound concerning the advisability of putting the entire factory on this plan.

An instance of changing policies without first proving the correctness of the conclusions may be cited from the experience of the X organization. They had been distributing their soap products through wholesalers and dealers. Their volume of distribution was unsatisfactory. The problem was studied, the facts gathered and analyzed, and the conclusion reached that the policy of distribution should be changed and the products distributed direct to the retailers. Without an attempt to prove the accuracy of the conclusion, the work of reorganizing the marketing division was started in order that the new policy might be put into operation. Great expense was involved in the reorganization necessary to distribute the products direct to the retailers. Not a great while after the plan was started, the policy was changed to what it formerly had been. Had the conclusion been proved by testing out the plan in a small section of the distributing area, it is likely that the inaccuracy of the conclusion would have been discovered, and the new plan would not have been tried. As it was, the experiment cost the company a considerable sum of money and was unsuccessful.

*Value of Any Analysis.* In summary it may be said that the value of any analysis of an industrial problem will be determined by the care and thoroughness with which the analysis is made. At no step in the analysis is it possible to make an assumption of fact or inference or to arrive at conclusions unwarranted by the facts. Each step must be made carefully and be verified as the analysis progresses to make certain that subsequent steps are not predicated upon erroneous bases. All the problems arising in the business must be solved speedily and accurately. Therefore, the plan of making the analysis should be in writing, and carefully worked out. Thus, the work may be done in a systematic manner with no loss of time or waste of energy.

One of the most fertile fields for the profitable application of these principles of scientific research is in connection with the many problems of managerial control which arise in course of operations. Management cannot function satisfactorily

without having always before it a clear cut and detailed picture of each major business transaction. Thus the collection and analysis of cost data provide much desirable information and facts for managerial use in the effort to maintain effective cost and operating control over the several activities of the enterprise.

*Purpose of Cost Analysis.* The full extent to which cost analysis may aid management has not as yet been determined. It will require much time and careful study to utilize cost data to the greatest extent. However, management has recognized many uses of cost data. A few of these uses are :

1. To determine profitable and unprofitable lines of product.
2. To secure profitable distribution.
3. To prevent and reduce wastes in use of raw material, processed and finished goods, supplies, productive and indirect labor, use of machinery, equipment and tools.
4. To secure and better existing control of materials and supplies, quality, quantity and lines of products, labor wages, and incentives.
5. To set and maintain standards.
6. To predetermine costs.
7. To budget.
8. To determine the effectiveness of work of executives, foremen and supervisors, promotion and training.
9. To aid in policy formulation, check-up and change.
10. To aid in planning for future expansion and projecting future conditions and results.
11. To aid financing.

Many other purposes and uses of cost analysis may be developed if the management will exercise care in the determination of necessary records and see that they are systematically compiled and properly used. A constant analysis of the business will almost always show where certain figures would be helpful in making decisions. When there is an apparent lack of figures or records of information, then plans should be made to secure these data. Records which are being used for an established purpose, if carefully analyzed, may be found to

contain additional information needed in some other field of activity.

Accurate and ready records of the business, made available when needed and so constructed that they may be correctly and accurately analyzed, are requisite to its successful operation.

## CHAPTER 2

### MANAGERIAL CONCEPT OF ORGANIZATION

Organization is one of the oldest arts known to man and may be defined as the art of collecting, arranging, classifying and grouping of all resources available in order to accomplish efficiently a clearly defined, unified objective.

To organize means to arrange the available resources so as to permit the achievement of the desired, unified objective.

A business enterprise consists of two primary factors, the physical and the human. The physical factors include buildings, machinery equipment, materials, and systems, while the human factor means the personnel required to carry out the purpose of the enterprise. The process of bringing these elements together in their proper proportion and in correct relationship to each other is called business organization. The determination of the required proportion of each must be made in the light of the specific needs of the enterprise; that is, in terms of stated objectives. The relationships which must exist to give continuity, balance and flexibility to the organization must be based upon the same considerations.

From the experience and philosophy of business leaders two radically different theories of organization have been developed. The first theory upholds the law of the survival of the fittest. This theory, though archaic in origin, seems to have a definite value to some leaders of the present time. It provides that those who have power will grasp more power, and that those who are not strong enough to hold the power that they have acquired, will lose that power.

A dominating and aggressive type of individual takes unto himself as much authority as he can secure and assumes such responsibilities as he must. It is likely that the struggle for authority will develop aggressive leaders with a high degree

of initiative since, within reasonable limits, it is possible for them to acquire as much authority as they can appropriate and efficiently use. This creates a tendency to weaken the ability and to destroy the confidence and initiative of subordinates. They are likely to become dependent upon the leaders and unable to make decisions or to act without guidance, even in cases of emergency. Another weakness of this theory is that the strong and aggressive individual who absorbs authority may not be capable of applying it effectively and may try to fix responsibility for his failure or incompetency upon the shoulders of others. This theory fosters the danger of fashioning an organization around one individual. This introduces an element of instability and lack of permanence and may be the cause of disaster if the individual in power should die suddenly or resign. Furthermore, it definitely limits the possibilities of expansion of the enterprise to the extent of the capabilities of that particular individual.

The charts (Figures 3 and 4) illustrate the points made above. The first shows the one person as the focal point of control and motivating center of all activities. The second chart shows the same activities without that unifying and motivating force. Confusion and disorder are the least but most immediate results of removing this center of control; more serious results follow unless someone can be secured to occupy this spot. For many reasons, it is extremely difficult to find a qualified person to fill such a vacancy.

Positive managerial control is based primarily on definite fixation of authority and responsibility together with the ability to measure results accurately. In an organization built around an individual, results cannot be measured with any degree of accuracy.

The second theory of organization holds that the operation of any business can be no more efficient than the efficiency of each of its several activities. This theory recognized the necessity of the division of labor and the division of the task; the perfection of method as an intrinsic part of the organization; that there are certain natural functions common to all business; and that the ultimate success of a business depends largely upon



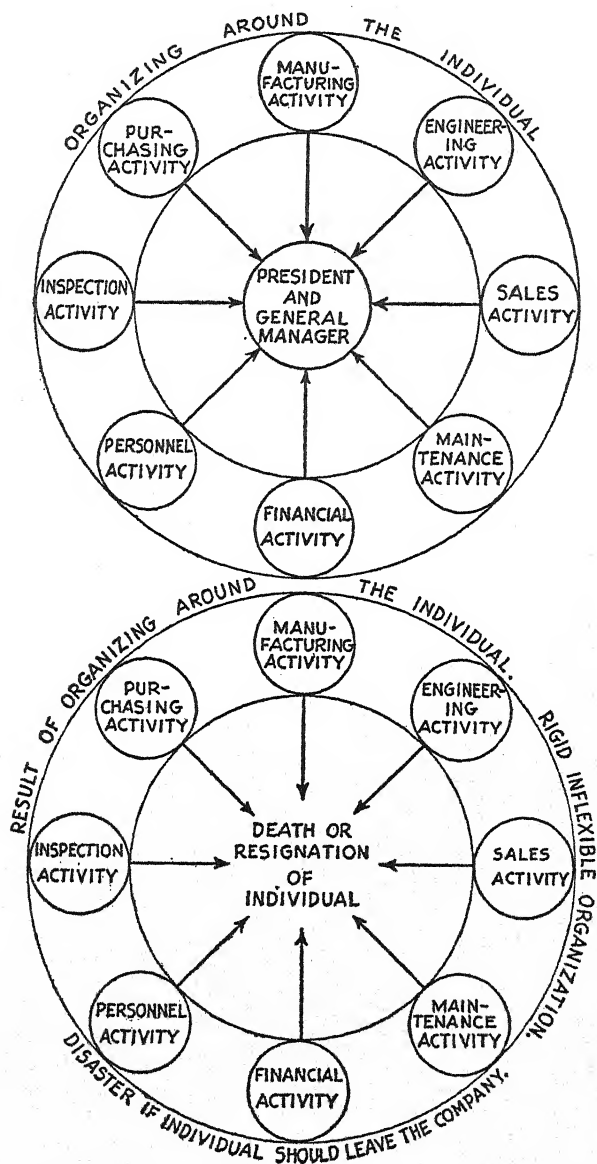


Figure 3. Chart Showing Probable Results of Organizing Around an Individual

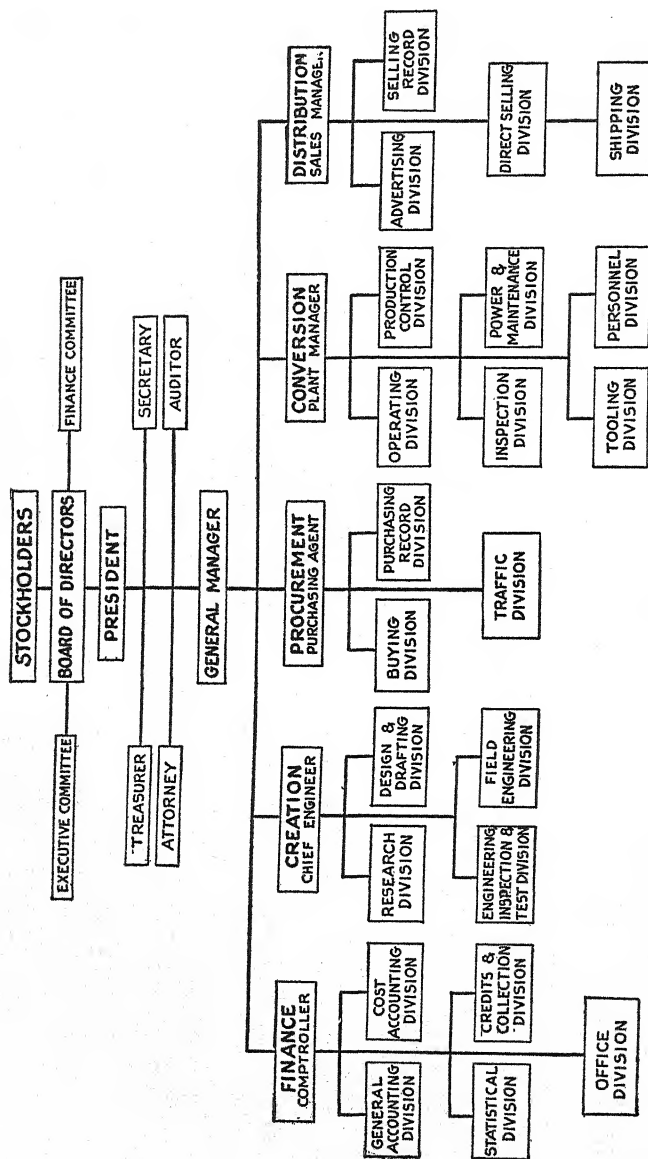


Figure 4. Chart Showing Organization Built Around the Functions of the Business

the extent to which its functions are balanced and coordinated. The chart (Figure 4) shows an organization built around the functions of the business.

**Problems in Organization.**—A business enterprise cannot be static in nature. It must vary and progress in order to keep abreast of the changing economic tide. Its permanence, expansion, and economical operation are jeopardized by any attempt to reduce its operation to a rule-of-thumb procedure. The recognition of this fact brings to light immediately a multitude of problems in organization which, of necessity, must be constantly in the minds of those executives whose responsibility is to solve these problems as they arise.

The ever-shifting emphasis of consumer demand, financial necessity, manufacturing expediency, changing personnel, and limiting factors of all kinds, make necessary the continuous adjustment of functions, duties, and responsibilities. Thus, master-planning, the amalgamation or separation of departments or divisions, the creation of new departments, the changing of duties, readjustment of responsibilities, shifting of emphasis, become problems of major significance and must be solved in order to bring about better coordination and balance.

Until recent years, business concerns have developed largely through the process of evolution. An opportunistic management arbitrarily solved those problems in organization which it recognized. The laws and principles applied in their solution were purely empirical. Many concerns have won success through this chance method, but the cost has been exorbitant and many businesses have failed to reach the profit-making stage.

The advancement of scientific management during the past two decades has done much to bring about a realization that the past experiences of industrial executives offer a sound basis for the development of a body of principles which provide the fundamentals for use in shaping and directing the growth and expansion of the business organization.

The result of the process of organization should be a structure of unified relationships, through the use of which

management can achieve the aims of the business. This structure consists of five fundamental functions expressed in terms of responsibility and authority, namely: (1) creation, which is the idea or design element; (2) finance, which represents the monetary aspects necessary in the formation of every business; (3) procurement, which is the obtaining of necessary materials and service; (4) conversion, which means changing the procured materials into salable commodities, and (5) distribution, which is the marketing or sale of the produced commodities or service. Thus, business organization means the arranging and grouping of these fundamentals so as to weld them into a series of interlocking units which will produce a coordinated and balanced business structure. This structure is the mechanism or master vehicle of management by which the aims or ideals of the business are put into action. Business organization may be defined, therefore, as the fusion of the fundamentals of business into a coordinated, balanced structure of administrative relationships, through which the aims and purposes of the enterprise may be accomplished. A business organization is a unit consisting of these fundamentals coordinated for the purpose of financial profit. It is directional in nature, that is, vertical and horizontal. In the vertical structure, the president is the apex and the worker the base, authority flowing from the apex to the base. In the vertical structure functions are aligned according to importance; those at the top are concerned with general policy formation, while at the bottom they are concerned with detail.

The horizontal structure of organization represents specialization which is the result of functionalization, and functionalization, in turn, has its terminus in departmentalization. In this horizontal structure the specialized activities are arranged on a horizontal ordinate according to the field of specialization, such as, the functions of creation, finance, procurement, conversion, and distribution. Within each of these individual functions, known as departments, there is organization on a vertical and horizontal scale; the head of the department being the apex and the worker being the base in the vertical combination, while the divisions are arranged according to special-

ized activity on the horizontal ordinate of the departmental structure.

The division is further subdivided into sections with a similar internal organization structure as that of the department and thus the whole organization edifice consists of specialized activities.

Organization must be considered in a dynamic sense in terms of responsibility and authority. Its principles must be so formulated that these two dominant factors may be maintained in every respect.

**Principles of Organization.**—The term principle means foundation or beginning and thus may be applied to any fundamental truth which is universal within its province.

Management and organization are very closely related. It is difficult to draw any hair lines of distinction between them. Organization, however, is a tool of management and there are principles which must be adhered to if successful organization is expected. Again, it must be remembered that some of these principles will be similar to those of management. Organizing is the duty of management but in order to organize, management must have definite principles for guidance.

The principles of organization are divided into two classifications known as the administrative principles and operating principles.

#### ADMINISTRATIVE PRINCIPLES OF ORGANIZATION :

1. Determine the objective of the enterprise by a careful analysis of the purpose.
2. Formulate definite policies.
3. Functionalize all activities.
4. Departmentalize all activity for control purposes.
5. Establish centralized control.
6. Select personnel best suited for each individual task.
7. Build for coordination.

#### OPERATING PRINCIPLES OF ORGANIZATION :

1. Formulate definite methods, systems and procedures for performing the work.

2. Establish standards for all phases of activity.
3. Establish and maintain records for each phase of activity.
4. Develop and employ research technique to promote advancement and adjustment in all activities.
5. Develop and maintain positive executive control.
6. Develop hearty cooperation between all personnel.
7. Maintain balance and flexibility in organization.

### Administrative Principles of Organization

The principles upon which sound organization is premised are basic concepts from which arise plans, methods, and procedures that aid in the building and maintaining of an efficient organization structure. These principles cannot always be fully applied by management because of the pressure of certain limiting factors.

**Determining the Objectives.**—Sound objectives are essential to the successful commencement of an enterprise and play an important part in its continued successful existence. Thus, it is essential that the ultimate objective be analyzed with thoroughness to discover if it is sound and attainable. It is always a costly error of judgment to promote an enterprise dedicated to an unattainable objective.

This analysis consists of a comprehensive study of the products, their manufacture, distribution, financing, and all other activity connected in any way with the entire project, including buildings, equipment, and personnel. The conclusion drawn from this searching study of all the gathered facts form a basis for determining the organization requirements. After certain of these facts have been interpreted in terms of guiding policies the shaping and construction of the organization may be undertaken.

**Policy Formulation.**—A business policy is an accepted principle of procedure used by management as a guide in directing, controlling, and coordinating business activities.

In general practice the board of directors is responsible for formulating the general policies for the company. These policies deal with such subjects as public relations, financial

management, the relations with other companies in the industry, and relations to government.

The major policies based on the general policies are formulated by the president and his major executives and deal with major internal and external affairs.

The departmental policies based on the major policies are formulated by the general manager and the heads of the various departments and deal with departmental matters.

An interlocking series of policies constitute an efficient tool of coordination for each executive in the company and provide clear and definite statements covering the direction of its activities.

**Functionalize Business Activities.**—Functionalization is defined as that process in organization which recognizes all functions or activities of the business; determines the necessary and desirable activities; and provides for the proper combination of similar, related or complementary activities into major functional groups.

The analysis of the objective will show the nature and scope of the varied activities, which will be required to achieve the aims dictated by the objective. These activities must be classified and grouped according to their relationship, one with another, so as to provide for coordination and balance within each structural group. The determination of the relative importance of each of these groups of activities provides management with criteria for placing each in its proper position in the organization structure; permits the accurate determination of personnel and the correct delegation of responsibility and authority. Minor unrelated activities may be attached to major groups for administrative purposes.

**Departmentalization of Activity.**—The term departmentalization is defined as the creation and establishment of physical organization units, to facilitate the execution of the work assigned to the functional activities. Each department so established will usually include one single independent major function, a single major function with related minor functions,

or a group of similar or related functions or activities, no one of which is of major importance.

A department should consist of all those activities necessary to the conduct of one major function of the enterprise and is separated from all other major and minor groups.

**Advantages of Departmentalization.**—The following list summarizes the major advantages of departmentalization:

1. To permit the maximum division of labor and specialization of task.
2. To make possible the transfer of skill and ideas.
3. To facilitate the definite assignment of responsibility and authority.
4. To facilitate the establishment of operating standards.
5. To bring about better balance in organization.
6. To permit more logical layout and flow of work.
7. To allow for greater elasticity in organization.
8. To make possible the issuance of definite written instructions.
9. To assist in the scientific selection of personnel.
10. To facilitate the collection and use of cost information.

**Establish Centralized Control.**—The purpose of organization is unity of functioning which can only be brought about by centralized control through the delegation of authority and responsibility to those in charge of the various organization units. Each executive must be held strictly responsible for the efficient operation of his unit, the control of which must be centralized in him.

The creation of organization units such as departments, divisions and sections or other functional units is, in effect, the application of this principle.

**Selection of Personnel.**—The motivating force of a business is its man power. The choice of its workers from the bottom to the top must be made with as much care and precision as modern scientific methods will permit. It is not a problem of choosing the best available personnel but it is a



problem of choosing the personnel most suited for the work to be performed. Selection presumes a knowledge of the work to be accomplished, and modern management advocates the analysis and classification of each job as a basis for selecting the personnel. The selection must be based on the fitness of the individual to perform the work stated by the job specification compiled from the job analysis. Such mechanisms as have been made available by the psychologist, sociologist, and all other scientists must be resorted to in an effort to secure the best possible worker for the specific work. No one can even estimate the bearing which proper selection of workers of all grades has on costs. It requires no accounting figures, however, to quickly determine that improper and poor selections are costly.

**Build for Coordination.**—In the process of organizing an enterprise the principle of coordination must be applied to each step in the process, so that a balanced structure will result. Coordination cannot exist unless it is built into the structure and further, it cannot be developed once the enterprise is underway except by reorganization.

An enterprise must concentrate its energies along the line of its objective and each organization unit within the whole must bear its burden and perform its appropriate share of the work based on its particular functions. This cannot be accomplished without coordination.

Coordination in organization means the act of placing an activity in harmonious or reciprocal relationship with all other activities. The application of these administrative principles of organization will aid in the development of an organization structure suitable for the needs of the enterprise and such a structure will be so flexible, well-balanced and coordinated that it will serve as an effective tool of management.

### Operating Principles of Organization

The administrative principles of organization are designed to guide the enterprise in developing a structure that will be most suitable and effective in accomplishing the results desired. The

operating principles of organization are designed to aid management in preserving this structure in such a form as to make it more adaptable for the needs of the management. These principles are derived from and formulated to support the administrative principles. They are closely allied to the principles of scientific management, and must be coordinated with those principles, if management is to be effective.

**Devise and Install Sound Methods and Systems.**—Good methods are the result of study, analysis, and research. There should be a spirit of keen competition between workers and the managerial staff in the search for better methods. If time and money are spent in the careful selection and training of the personnel, it follows that to make this expenditure profitable, time and money must also be spent in the search for improved methods. Change and adjustment are as much a part of business as the men and machines and unless methods are constantly studied and improved a resultant drop in productive efficiency follows. System brings order in the making of records, handling of work and conduct of detail. It is essential (a) to make executive effort fully effective, (b) to avoid confusion, (c) to aid in getting work performed by proper methods, and (d) to improve the quality of supervision. System aids, (a) in building up well-defined routines, (b) developing simplified practices, (c) setting standards, (d) increasing uniformity, and (e) measuring production.

**Develop, Install, and Maintain Standards.**—Standards are scientifically determined criteria; they are progressive in nature and must not be considered as ultimate, they serve as specific objectives, they act as guides in the work of attaining other objectives and they act as yardsticks to measure progress, performance, or products, they facilitate planning and control, they aid in personnel selection and in a multitude of other ways, and they assist in cost reduction and improved operation.

**Establish and Maintain Records for Each Phase of Activity.**—Classify and arrange the essential data concerning the transactions of the business; present such of these data to

company officials as will aid them in the more efficient discharge of their responsibilities. The value of a record depends upon:

1. The quality of the record.
2. The timeliness of the record.
3. The need for information on the subject covered by the record.
4. The ability of the individual to make use of the information.
5. The arrangement of information to permit instant use.

**Develop and Employ Research Technique to Promote Advancement and Adjustment in All Activities.**—The development of new products, new and substitute materials, new and improved methods and processes, machines, equipment, tools, and practices are but a few of the numerous benefits that grow out of organized research in business. In a wide variety of ways, the conduct of research aids in cost reduction both directly and otherwise. Many business men emphasize the cost of research but fail to realize that its contributions to progress and efficiency usually greatly outweigh the cost.

**Develop and Maintain Positive Executive Control.**—The application of this principle involves not only the selection, training, and compensation of the executives, but it involves also the development and maintenance of all those mechanisms which aid in control, such as records, systems, standards, budgets, charts, manuals, standard practice instructions, and others. In the application of the administrative principles of organization, centers of control have been created and definite responsibility and authority assigned. These are cardinal steps in maintaining definite control of such adjustments, and changes must be made in these assignments as changing conditions, personnel, and other factors warrant. Failure to perfect any one of these mechanisms or to make administrative adjustments weakens the control of the activities and thereby gives rise to new opportunities for increased costs and reduced efficiency in operation. The function of control is the responsi-

bility of management and from the junior supervisor to the ranking executive all engaged in the discharge of this function must be properly trained for the work, equipped with required authority, and supplied with such instruments as will enable them to measure, regulate, plan, and execute.

**Develop and Maintain Hearty Cooperation between All Personnel.**—Cooperation is essential to harmony in an organization and management must strive to create and maintain harmonious relationships between its personnel, so that each individual will be satisfied and put his best effort into his allotted task.

**Maintain Balance and Flexibility in Organization.**—The pilot of an airplane which is not properly balanced in its structural composition endangers his life when he takes that airplane into the air; the manager of a business endangers its success when lack of balance in the organization structure is permitted to continue. Good balance in the airplane is a matter of design and construction adhering to known principles; good balance is built into the organization structure in the same manner through the scientific application of those tested principles which have been discussed in this chapter. However, good balance will not perpetuate itself nor can the organization structure remain in a static condition. As business and economic pressures are exerted upon an enterprise its objectives, plans, and policies change. As these changes take place the organization structure must be adjusted accordingly. This is a conscious process carried on by the management, and unless every changing demand is met by a corresponding change in the organization structure, balance cannot be maintained for long.

With the disturbances which lead to waste, duplication of effort, slowing up of work, indifferent or unfriendly human relations, and other conditions of a similar nature will quickly develop. The only way in which good balance can be retained is for the responsible executives to maintain such a close watch over each activity of the business that its needs are al-

ways known and met without delay. The mechanisms through which the executives may place and keep themselves in an informed position have been mentioned in connection with the principle of positive executive control. The ability of the executives to know that change is needed is not sufficient; they must possess the ability to devise new policies, plans, and methods to meet those needs and to bring about their prompt and effective adoption.

The problem of maintaining flexibility in the structure is an essential part of the problem of balance and is solved in the same manner and with the same mechanisms and executive actions. A business must possess sufficient flexibility to permit it to meet emergencies, to contract or expand as changing conditions may warrant. It must be in position always to protect itself against labor and material shortages and other such contingencies as will surely arise from time to time. A business organized around individuals seldom possesses flexibility. It is limited in every way by the individuals who govern it. A business organized around its natural functions automatically takes on a certain degree of flexibility and it is not difficult for it to expand, contract, or to combine functions. Too much rigidity in organization greatly limits its use as a tool. It prevents the grasping of desirable opportunities and the adjustment to new methods or ideas which is so essential to permanence and growth.

A most important element in building, reshaping, and maintaining good organization is the hearty and voluntary cooperation of every individual associated with the enterprise. Plans may be well conceived and adequate to the situation, but their execution is a matter of human relations. It makes little difference how carefully the organization structure was planned or what policies and methods have been designed to maintain it in suitable condition, unless a high spirit of willing cooperation pervades the entire working force. Cooperation is an attitude that is a result of training and association; it must be cultivated and rewarded if it is to be perpetuated. Money spent in furthering and fostering good teamwork is usually well spent in terms of its yield in smooth, frictionless, and effective co-

operation of all agencies engaged in the achievement of a desirable objective.

**Limiting Factors in Organization.**—In every business concern there are factors which prevent the complete application of the principles of organization in the development of its structure. Factors such as company politics, personalities, preconceived opinions, self-interest of major executives, tradition, family ties, inaction, availability of personnel, as well as many others of equal weight, are typical of those to be dealt with.

**Responsibility of Selection of Organization Plan.**—In the application of the theories of organization several basic plans have been evolved for the determination and arrangement of activities and relationships of which organization consists.

The broad interpretation of this responsibility places it as an administrative function of the board of directors. However, in practice, the board of directors will seldom go beyond the point of making a broad, general statement as to the plan of organization to be developed. The details and the practical working out of the plan is the responsibility of the chief executive officer—the general manager or executive vice-president. Since the structure developed is a tool of management, it follows that the chief executive should be responsible for developing a plan that will be most effective for his use.

**The Basic Plans of Organization.**—The evolution of these plans corresponds very closely to the growth and development of business. When the business unit was small and contacts direct and personal the Line plan was most effective. As the size of the unit increased and the scope of its activities widened, greater output and less personal contact made necessary a separation of activities and in this manner the functional plan developed. In the present stage of business progress, where mass production and individual specialization are important characteristics, a combination of the two earlier plans into what is known as the Line and Staff plan is in many instances found to be a more serviceable tool for the manager to use in directing and controlling his enterprise.

**Committees in Organization.**—The so-called “Committee” plan is more properly an idea than a distinct plan. The idea is seldom used as the basic plan of organization but rather in conjunction with or supplementary to the plan being used. The flexibility of committees is so great that the possibilities of their use are almost unlimited. Usually, certain desirable committees are superimposed upon the existing organization plan.

Committees are usually organized after the pattern of staff and have no authority to act. Their primary function is to discuss, investigate, and recommend action. Many exceptions are noted where certain committees have the power of action and once the committee has reached a decision, it is promulgated as the edict of management and must be observed by all concerned. The character of the organization and the scope of the committee activity will usually determine whether or not the committee is to have authority or is merely to act in an advisory capacity.

A committee to deal authoritatively or in an advisory capacity with problems of cost control may be organized as a coordinate unit or an adjunct to the technical organization unit charged with the responsibility for cost control work. It is clear, however, that in either case, the scope of the committee and its authority would necessarily be limited. Costs arise or are incurred wherever a business transaction or event occurs and in order to maintain effective cost control, it is necessary that the supervisory and executive personnel be assigned individual and functional responsibility for the control of costs. Thus the problem of organizing for cost control becomes difficult and requires careful study and planning.

**Organizing for Cost Control.**—When organizing for cost control one must observe all the fundamental principles of organization and create a series of interlocking units so that accurate records of all phases of operations may be established and maintained.

The first step in the organization for cost control is to carefully examine each of those activities or conditions which bear

directly upon business costs. In this group may be included the company organization structure; quality, fitness and assignments of personnel; company policies, and practices.

The second step is to develop yardsticks, such as standards and budgets which express estimates of probable or possible performance and accomplishment in order that actual results may be examined in relation to expectations.

The third step is to train executive and supervisory personnel how to discover variations in costs, their causes and underlying reasons, and how to formulate plans, policies, and practices that will correct the reasons or remove the causes.

The fourth step is to develop and install a cost accounting system that will permit the necessary detailed records of costs to be collected and recorded at such intervals and in such manner as may make them most suitable for executive use.

The fifth step is to set up the procedure for analysis and preparation of reports.

The total cost of a product or the operation of a department is of some value and interest, but the examination of costs by costs of parts, operations, processes, or other detailed units of product or activity brings to light the information upon which positive control must be based. The cost accounting system, therefore, must be so developed as to provide this detailed information which must be collected by such physical units as will correspond most closely to the break-down of responsibility and authority.

**Departmentalizing for Cost Purposes.**—An organization department may include many activities which from a cost point of view are so dissimilar as to make it impossible to select a uniform method of applying manufacturing expense against the product by the organization department. It, therefore, becomes necessary to departmentalize for cost purposes also. This consists in the establishment of cost or production centers within an organization department. Such cost or production centers embrace a single activity, or a group of related activities, in which the work, machines used, and expenses are much alike. For example, in the automatic screw machine



division usually there will be both automatic screw machines and hand lathes. It is obvious that the parts being produced by each class of machine will not absorb the same amount of manufacturing expense. Therefore, cost or production centers must be established to facilitate the accurate allocation of manufacturing expenses incurred in operating the product on these different machines. As a rule, the expenses incurred in automatic screw machine operation will be allocated to the product on a machine hour basis, while the expenses of operating hand lathes will be allocated to the product on a direct labor cost or direct labor hour basis.

**Factors Influencing Cost Departmentalization.**—The primary factors which influence and to a large degree determine the number and extent of cost or production centers to be established are:

1. Similarity of work.
2. Similarity of processes or operations.
3. Similarity of machinery.
4. Similarity of expenses incurred.
5. Physical limits.
6. Supervision.
7. Information required.
8. Value of information.

Unless the above factors are considered in establishing cost or production centers, management will be seriously handicapped in the analysis and control of manufacturing costs. This is true because costs will be mixed, the different elements of unlike costs cannot be separated, various products will be charged with incorrect amounts of expense, and the primary purposes for creating the production or cost centers will be defeated. For example, in a large metal-cutting industry nickel plating is performed by two different processes. In the first case, large parts are nickel plated by the use of a continuous plating machine which requires the services of two laborers. In the second case, smaller parts are nickel plated by a tumbling machine. It is obvious that the continuous

plating consumes more motive power, labor, and other indirect expenses than do the tumbling machines. Because of this condition two production or cost centers should be established so as to obtain accurate costs of each process.

**Cost Division Organization.**—Definite functions must be placed under the line control of the cost division while

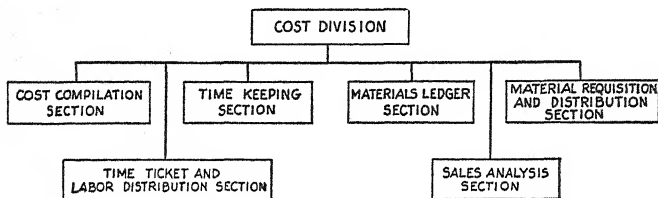


Figure 5. Cost Division Organization

others should be under its functional control. A well-organized cost accounting division should consist of the above activities which are thoroughly explained in Chapter 30.

Another fundamental feature of cost control is the close co-operation required between the engineering department and the cost division in furnishing the necessary engineering drawings and specifications for the product. The modern cost accountant should have an engineering training along with his accounting knowledge so that he may understand the technical process and the engineering specifications which accompany the production order.

Most of our progressive manufacturers have installed a separate staff function under the direction of the general manager known as the "Cost Reduction Division." This activity is under the jurisdiction and supervision of a graduate engineer, its purpose is the analysis of all cost data with a view of reducing the cost of manufacturing where possible by eliminating unnecessary or undesirable practices, operations, labor, materials, and equipment. It acts as a stabilizer on the cost accounting division in that all costs pass through the cost reduction division where they are carefully checked with engineering estimates.

## CHAPTER 3

### BUSINESS STANDARDS AND RECORDS

**Definition of Terms.**—There is at the present time a definite need for standardization in terminology in the field of business management. Many definitions have been accepted by the profession, but there is still a lack of uniformity in their usage. However, since the work has not been satisfactorily accomplished and since the individual interpretation of a term may be challenged by some who may not know just what the writer had in mind, it is well to offer various accepted definitions of certain terms.

A. *Standard*.<sup>1</sup> “Something which is set up as a unit of reference.”

“A measure set to gauge efficiency.”

“A carefully thought out method of performing a function, or carefully drawn specification covering an implement or some article of stores or product.”

B. *Operating Standard*. An operating standard is a predetermined estimate of accomplishment for a product, man, machine, or operation, based largely upon past experience and existing conditions.

C. *Standard Method*.<sup>1</sup> The best method that can be devised at the time the standard is drawn.

D. *Standardization*.<sup>1</sup> “Standardization in a manufacturing sense is the reduction of any line of product to fixed types, sizes and characteristics.”

“Standardization primarily means getting up standards or ‘measuring sticks’ by which extent, quantity, quality, value, performance, or service may be gauged or determined, and is the

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<sup>1</sup> Cost and Production Handbook, The Ronald Press Co., N. Y., pp. 303-304.

crystallized best thought and practice of industry or art into definite forms for general usage."

"Standardization is the liberator that relegates the problems that have been already solved to their proper place, namely, to the field of routine, and leaves the creative faculties free for the problems that are still unsolved. Standardization from this point of view is thus an indispensable ally of creative genius."

"The function of standardization is economy—a standard should deviate to the least possible extent for economical current practice."

E. *Simplification*.<sup>1</sup> " . . . non-scientific standardization of type." That process that determines the optimum number of types, sizes and grades of manufactured products.

"Simplification is that policy of management which seeks to eliminate waste by eliminating unnecessary variety and non-essential differences in articles or commodities in every-day use."

"Simplification . . . has to do with the elimination of superfluous sizes, dimensions, types, etc. of every day commodities, for the purpose of reducing costs all along the line."

"Simplified practice comprises those methods whereby simplification is applied throughout an entire industry to products or methods of that industry." By "entire industry" is meant manufacturers and producers, distributors, and users of the products.

F. *Ratio*. It is the relationship of a unit or quantity to a similar unit or quantity expressed as a quotient and obtained through dividing the first by the second.

G. *System*. A plan, method, or scheme, by which ideas or things may be interrelated; an assembly of objects arranged in regular subordination, after some distinct method, usually logical or scientific; an aggregation or assemblage of objects united by some form of regular interaction or interdependence. (Webster)

H. *Record*. Denoting a performance, occurrence, or condition which goes on, or is extraordinary among others of its kind; reduction to writing as evidence; that which is written or transcribed to perpetuate a knowledge of acts or events. (Webster)

**Importance of Standards.**—The organized use of scientifically determined standards is of recent origin and is

considered a valuable managerial tool. As management progresses in its research and operations, it is reasonable to believe that it will make a much wider use and take greater advantage of standards in all phases of its work.

At the present time standards are of sufficient importance to be indispensable in the conduct of business and their use for the following purposes will demonstrate this fact:

1. To provide a basis for analysis of conditions and requirements.
2. To provide definite tasks or goals to work toward.
3. To make possible the measurement, comparison, effectiveness of all phases of business activity, if standards can be set for those activities.
4. To procure uniformity of product, process, and method.
5. To facilitate the work of simplification.
6. To aid definitely in the scientific selection of personnel and facilitate training and supervision.
7. To establish and maintain definite planning.
8. To establish and maintain an equitable wage payment plan.
9. To facilitate purchasing, engineering, inspection, and all other activities.
10. To facilitate the keeping of records and record keeping.
11. To promote cost reduction and control.
12. To promote and control research, improvement, and managerial coordination.

**Characteristics of Standards.**—There are certain fundamental characteristics which should be possessed by all standards, even though each individual standard may be to some extent conditioned by surrounding circumstances; such as, purpose and company policy. Among those characteristics which make a standard satisfactory may be included the following:

1. The standard must be scientifically constructed. Guesswork standards are dangerous at all times. Facts, scientific data and dependable experience are sound bases for standards, but these are not available always to the degree desired. However, the best

possible approach to scientific methods must be used in formulating all standards.

2. The standard must be simple. Complex standards are difficult to formulate, difficult to calculate, to understand, to interpret and to use. Such standards many times defeat the purpose for which they are established and promote errors of interpretation, judgment and decision.

3. The standard must be comprehensive. A standard of performance that does not consider necessary allowances is generally unsatisfactory.

4. The standard must be flexible. A standard once set should remain effective until circumstances and conditions make it desirable to formulate and establish a new standard.

5. The standard must be kept current. Standards must be examined constantly to give effect to changing conditions in business.

6. The standard must be stated in terms of comparable units. Unless the standard is expressed in the same unit as that used in the data with which the standard is compared, the value of the standard is worthless. If the unit of expression is indefinite or vague, comparisons will likely be unsatisfactory. The unit chosen should be easily understood and, if possible, in general use. Strange terms such as decibels of noise and microns of dust are not in common use and may lead to confusion or loss of value of the standard.

7. The standard must be accurate. Company standards that have been inaccurately formulated may not be harmful outside the company but in most cases the possibility that they will be harmful is always present and often materializes. If performance standards, standards of quality, or any others, are inaccurately determined, their use may cause loss of time, money, prestige, and friction within the concern. Inaccurately set standards of performance for factory workers, which serve as bases for measuring output, planning and controlling production, and setting wage rates, can do much to destroy employee good-will, upset plans and budgets, and reduce efficiency of operation.

**Preliminary Studies.**—In order to establish standards with any degree of accuracy, there must be made a complete and

detailed study of each individual unit or department for which standards are being set. Thus, each element of a man's work, each machine, and each process or operation, must be carefully studied in order to determine present existing conditions. Then, by a process of elimination of undesirable factors, a standard may be set.

Many additional elements must be considered in establishing standards so that the standard set may be of real value to the business. Such elements as the general policy of the business, prevailing market conditions, financial policy, purchasing policy, factory equipment, methods of production, and labor conditions, must all be weighed carefully. To this end it is necessary that the individuals engaged in establishing standards have a comprehensive knowledge of all phases of the business in order to determine properly what constitutes a standard.

**Problems in Setting Standards.**—There are at least four distinct types of problems involved in standards work, as follows:

1. Problems of educating company employees and management in the purpose and use of standards. Many carefully planned programs of setting standards have come to disaster because factory and office workers were not trained to understand their purpose or value. The so-called "Stop Watch" method has been used too frequently to speed up production without commensurate pay increases, which makes workers suspicious of company motives when the establishment of operating standards is undertaken. Similarly, standards of method, quality, materials, and all other types of standards, require the intelligent cooperation of all persons concerned for proper construction and maintenance. This cannot be secured without first educating the personnel as to the purpose and use of the standards. The management of an enterprise can bring about the installation of standards through the exercise of its authority, but that management cannot make the program effective in the same manner. Standards play such an important part in company relations with workers, consumers, and the public at large, that the interests and attitudes of all must be

considered and corrected if the program of standards is to avoid contact with insurmountable obstacles.

2. The second problem is to recruit or to train qualified personnel to carry on the standard's work. A large part of the success of the program will depend upon the ability of those engaged in the work to do it well. This does not mean with accuracy only, but with the knowledge, understanding and consent of the workers and supervisors with whom they contact, as well as with the more advanced management. It is false economy to engage persons for standards work who are not particularly well qualified in all respects for it, no matter how cheaply their services may be secured. Any individual well qualified for the work demands and receives from those who understand its importance a salary commensurate with the task. Many illustrations could be offered of disastrous experiences resulting from placing this work in the hands of poorly qualified men.

3. The third type of problem to be solved is that of controlling or appraising the effect of those physical factors which must be dealt with. A change in the volume of work, the intermittent flow of work, or a change in the kind of work, might increase the difficulty of setting a standard, or even make it impossible, or impracticable, to set a standard for that job. Conditions of a like character can and do arise in connection with setting standards of procedure and other managerial standards. The situation must be analyzed carefully at the time the standard is being constructed to be certain that each affecting physical factor has been recognized and dealt with according to its bearing upon the proposed standard.

4. The cost of setting and maintaining standards oftentimes proves a difficult problem to handle. Many concerns have a fair appreciation of the value of standards but they believe the cost of the work exceeds its value and, therefore, do not undertake it, or they attempt to economize in getting the work done by assigning underpaid and untrained personnel to the task and not making necessary revisions and changes in standards, or not doing either part of the task scientifically. It is not uncommon to find as many as twenty-five to fifty thousand



individual studies in a moderately small manufacturing plant and many times that number in a large plant. Where properly trained and qualified personnel are used in the work, where the scientific method is employed, where constant study, revision and adjustment of standards is made, the cost is high but in such cases the benefits far outweigh the costs, if the management has been trained properly in the value and use of standards.

**Classification of Standards.**—Those standards which for the most part are established by the engineering, or other technical branches of the concern and which, in general, relate to dimension, quality and method in relation to construction, products, processes, tools, machines, quality, inspection, arrangement, and similar factors, may be regarded as “technical” standards.

Those standards which are formulated by the management of the concern and which are used in the direction, control and coordination of its activities, may be classified as “managerial” standards. This group may be subdivided into three primary classes:

1. Financial standards
2. Operating standards
3. Procedure standards

Financial standards are those yardsticks and relationships constructed from the balance sheet and profit and loss statement which aid in the more effective management of the financial affairs of the concern and provide, in many ways, the starting point for the use of many operating standards to insure better control over operations and to reduce costs. Operating standards are those standards of individual and group performance of men, machines, and methods which form such a vital mechanism in the control of departmental activities, as well as the costs of conducting these activities.

Standards of procedure are those standards designed to bring about the improvement and maintenance of systems and methods of performing necessary work and to aid in the

building of routines in order to free executives of detail. These standards apply in all organization units of the company and are utilized together with many technical standards.

**Functions of Standardization.**—A careful re-reading of the definitions of standardization offered on pages 43 and 44 will indicate in a broad way the functions of standardization, of which there are two.

The first function deals with the development of uniformity, the crystallization and codification of best practice, and the unification of methods, practices, or the elements of the product, process, operations, or materials.

The second function relates to the development and application of interchangeability of such activities, methods, materials, machines, process, or products as it can be applied to profitably.

In a broad way, the purpose of standardization is to promote the more efficient and economical uses of the energies and facilities of business to the end that a more satisfying service can be rendered to consumers and a larger net return can be earned upon the capital invested in the enterprise. The immeasurable importance of interchangeability as it affects production and use of goods and services, and as it operates as a significant influence in the shaping of the social structure deserves to be emphasized strongly. One of the keystones in large volume production, high quality and low cost products, high wages and high standards of living, has been fashioned by the application of the principle of interchangeability.

**Scope of Standardization.**—The American Standards Association suggests the following to be included in the scope of standardization:<sup>2</sup>

1. Most favorable varieties:

Elimination of unnecessary types, sizes, and grades, selection being based on relative commercial demand and concentration upon the optimum, or most favorable,

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<sup>2</sup> Cost and Production Handbook, The Ronald Press Co., N. Y., p. 307.

number of types, sizes, and grades of manufactured products.

2. Nomenclature:

Definitions of technical terms used in specifications and contracts and in other technical work, abbreviations, symbols for quantities used in equations and formulas, graphical symbols.

3. Dimensions and Proportions:

Uniformity in dimensions necessary to secure interchangeability of parts and supplies, and the interworking of apparatus.

4. Specifications of quality for materials and equipment.

5. Methods of test.

6. Ratings of machinery and apparatus:

These establish test limits under specified conditions, as a basis of purchase specifications, or establish requirements as to performance, durability, safety, etc., under operation.

7. Provisions for safety.

8. Rules for operation of apparatus and machinery in industrial establishments.

9. Management standards:

Included in this are classification, procedures, and routine for the various functions and operations in manufacturing establishments.

**Principle of Standardization.**—To further emphasize the fact that standardization is a valuable tool to management, modern students of the subject have thought it of sufficient importance to embody it as one of the significant principles of management. William B. Cornell,<sup>3</sup> in his most recent textbook on Business Organization and Management, states the principle as follows: "When ever practicable, best practice should be determined, expressed in terms of definite units or standards and adapted as a pattern for use in operation or performance and in planning and control."

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<sup>3</sup> William B. Cornell, *Organization and Management*, The Ronald Press Co., N. Y., 1936, p. 63.

L. P. Alford,<sup>4</sup> in his book on Manufacturing Management, states a law of standardization as follows: "Predetermined results, established procedures, fixed types, sizes and characteristics of products, improve operation and reduce cost of manufacture."

To this statement of the Law of Standardization, there has been added a series of corollaries<sup>5</sup> which greatly aid in the interpretation and application of standards.

Corollary 1. Interchangeable manufacture reduces manufacturing cost and, all other characteristics being equal, produces a product of maximum serviceability.

Corollary 2. A standard, in order that it shall raise rather than lower the standard of products, should deal with those elements, or principles which are sufficiently understood and recognized to be stable. It should be concurred in by the most competent experts, so that their consensus, as crystallized in the standard, can be expected to control production for a reasonable period. However, a standard should deviate to the least possible extent from economical current practice and where practices vary over a large range, effort should be made to follow the main path of common practice, if, thereby, economy and utility do not have to be sacrificed.

Corollary 3. The value of a standard increases rapidly with the extent to which its provisions are based upon and verifiable by measurement. Therefore, those elements of a standard which depend upon, or are decided by personal judgment, unaided by instrumental measurement, should be reduced to a minimum.

Corollary 4. Difficulty of arriving at a standard is increased by the number of departments of an industry or conditions of application which it must serve and satisfy.

Corollary 5. Every standard should be subject to revision from time to time in order that it shall continue to reflect the available and applicable knowledge of the art.

Corollary 6. Standardization focuses the attention upon the essential elements of the object under consideration and thereby

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<sup>4</sup> L. P. Alford, *The Laws of Manufacturing Management*, The Ronald Press Co., N. Y., p. 192.

<sup>5</sup> *The Cost and Production Handbook*, 1934, p. 320.

transfers competition to a field in which it has a positive social value.

**Simplification.**—Writers on the topic of simplification have not all agreed as to its meaning or difference from standardization. One point of view holds that simplification is the adoption of optimum sizes, varieties, colors, qualities, etc. Another holds that it is the reduction of varieties, sizes, colors, etc., without necessarily standardizing on the remainder. Still others have considered simplification a useful term only when discussing an industry-wide movement and have then preferred to say simplified practice rather than simplification.

Its purpose is to bring about the reduction of needless varieties, sizes, colors, dimensions, weights, etc., of parts, products, tests, technical methods, machines, tools, and other elements and conditions. After this has been accomplished, standardization of the remainder may take place. From the viewpoint of management, simplification is applicable throughout the enterprise and should be applied to procedures, systems, work methods, furniture, fixtures, office machines, and all practices wherein it has value.

An application of the principle of simplification should not be made to parts and products until the market has been analyzed carefully; past sales have been checked and studied; manufacturing possibilities and relative efficiencies have been determined; and all other factors influencing changes in lines of product, marketing methods, manufacturing setups, production machinery and tools, have been thoroughly studied. Similarly, in its application to office systems, procedures, methods and practices, the same careful study must precede actual change. Requirements for each must be known and understood in order to increase efficiency and to gain the cost and other advantages available through proper application of the principle.

**"Results and Benefits of Simplification."**<sup>6</sup> Cooperation of manufacturers, wholesalers, or retailers, is essential in developing any simplified practice. Advantages or gains which should accrue

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<sup>6</sup> Cost and Production Handbook, pp. 312-313.

to each through elimination of excess variety are principally these:

"Gains to manufacturers are:

1. Less capital tied up in
  - (a) Raw material
  - (b) Semi-finished stock
  - (c) Finished stock
  - (d) Jigs, templates, and special machinery
  - (e) Storage floor space
  - (f) Repair parts
2. More economical manufacture through
  - (a) Larger units of production; reduced number of manufacturing units
  - (b) Longer runs, less frequent changes of machine setups, etc.
  - (c) Higher rates of individual production
  - (d) Accurate and proper estimating for production
  - (e) More effective stock control
  - (f) Better and more simplified inspection
  - (g) Less idle equipment; reduced amount of equipment
  - (h) Greater ease in securing raw materials, and conserving raw products
  - (i) Less expensive handling of stock
  - (j) Reduced clerical overhead per unit produced
  - (k) Simplified and more accurate cost accounting
  - (l) Elimination of waste in experimentation and design
  - (m) Standardized material inventories
3. More efficient labor due to
  - (a) Simplified training of employees
  - (b) Better earnings, through increased individual production made possible by longer runs
  - (c) Skill increased by repetitive process
  - (d) Less labor idle from preventable causes
  - (e) More regularized permanent employment

4. Better service to the trade in
  - (a) Better quality of product
  - (b) More prompt delivery
  - (c) Decreased quantity of sizes of packing required
  - (d) Less chance of errors in shipment
  - (e) Less obsolete material
5. Simplified selling
6. Increased rate of turnover
7. Easier financing
8. Fewer factory shut-downs
9. Compels attention to individuality in those features where it is desirable, by preventing attempts at individuality in those features where it is superficial and useless, and where standardization should prevail.

"Gains to distributors are:

1. Increased rate of turnover due to
  - (a) Elimination of slow-moving stock
  - (b) Staple line, easy to buy, quick to sell
  - (c) Simplified selling
  - (d) Greater concentration of sales on fewer items
  - (e) Standard of patterns that are proven best sellers
2. Decreased capital investment in
  - (a) Stock on hand
  - (b) Repair parts on hand
  - (c) Storage space required
3. Less stock depreciation and obsolescence.
4. Decreased
  - (a) Handling charges
  - (b) Clerical and accounting work
  - (c) Selling expense

"Gains to consumers are:

1. Better quality of product through ability of manufacturer to concentrate on better design and reduce manufacturing cost.

2. Better service on
  - (a) Complete products
  - (b) Repair parts
  - (c) Prompt deliveries"

**Organization for Company Standardization.**—Each individual enterprise that believes in the merits of standardization must proceed to the organization of its program for this work according to its needs, requirements, general company organization, and the several limiting factors that may exist. In any case there are certain fundamentals that must be given consideration. Many of these have been stated in the form of questions by L. P. Alford,<sup>7</sup> as follows:

In planning a program of standardization the industrial executive must consider and answer five principal questions:

1. Shall standardization be a conscious, selective, deliberate process, or shall it be by the 'trial and error method, accidental and haphazard'?
2. Shall standardization be based upon careful scientific investigation, involving research and the use of laboratory and technical staff, or shall it be based upon the common sense experience and knowledge of the manager, foremen, and workers on the job?
3. Shall the standardization work be centralized in a separate department, division, or plant bureau?
4. Shall standards and standardized processes and procedures be introduced as fast as knowledge of ways, means, and properties of materials permit, or shall they be introduced slowly and gradually?
5. What parts of the plant activity—materials, machinery, product, component parts, processes, procedures—are most readily, easily and advantageously 'all factors considered' standardized?

In organizing for a program of organization work, there are many detailed questions which will arise regarding techniques and methods to follow, preliminary work to be done, the or-

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<sup>7</sup> Cost and Production Handbook, The Ronald Press Co., N. Y., pp. 329-330.



ganization of a standards department, or the reorganization of existing organization units to make room for the added responsibilities involved if standardization is to be assigned to one or more of them; the determination of new company policies and the revision of existing policies; how the work is to be made effective; who is to be responsible for installing the program and the results secured; whether work is to be done in cooperation with national standardizing bodies and the industry, if there is an industry-wide program proposed or in operation, and a myriad of similar questions.

**Savings and Cost Reduction.**<sup>8</sup>—Savings, economies, and cost reduction from simplification and standardization ramify throughout all industrial operation, and under both mass production and job order work.

The principal economic advantages to be secured are:

1. Lower manufacturing costs, due to increased quantities, permitting adoption of mass production methods.
2. Lower selling prices due to lower manufacturing costs.
3. Improved product designs and manufacturing plans because supervision is concentrated on essentials.
4. Improved quality of product due to better concentration.
5. Reduction of inefficiency and waste.
6. More punctual deliveries.
7. Reduced stores inventory.
8. Increased turnover of capital.

**Records and Systems.**—The fundamental value to business of records and systems has been established beyond question. The value of records in comparison with their cost is questionable in every business concern. Managers frequently complain about the high cost of record keeping but to date little has been done to reduce the cost. The growth of employment in clerical work has been enormous during the twentieth century, notwithstanding the rapid progress in the development and application of mechanical appliances to aid in record keeping. Perhaps the most important factor in the cost and value of

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<sup>8</sup> Cost and Production Handbook, p. 305.

records is the careful determination by management of its needs for record information. Much record and statistical data are collected and recorded that serve no useful purpose. The elimination of this wasteful practice would not only serve to reduce record keeping costs but would facilitate the collection and recording of useful information.

Management must develop methods for determining what record information it needs, as well as methods for reviewing its needs from time to time, in order to authorize the collection of additional data, and to abolish records which are no longer required.

Other factors that influence the cost of record work are :

Lack of proper organization of the record activity.

Failure to use mechanical instead of manual methods.

Unsatisfactory selection, training and supervision of clerical workers ; poor wage payment plans ; lack of standards ; poor physical working conditions, and failure to plan the work.

**Characteristics of Satisfactory Records.**—Accuracy is the first requisite of a satisfactory record. Inaccurate records are worthless.

The second requisite is completeness. Partial information may be dangerous, unless the executive using it is aware of the fact that the data are incomplete, and this is not always known. Accuracy is a matter of training of workers in the exercise of care in the work and its checking. Incompleteness is usually a matter of poor judgment on the part of the person determining what data are needed. The one sure way to avoid incomplete data is for the executive using it to specify in detail precisely what he requires and to insist on getting it. An executive may make mistakes in the interpretation of a record or find that it possesses very little value because of its complicated nature.

Simplicity is the third requisite and greatly to be desired in all records, even though the person to whom it is submitted may be capable of understanding it when presented in a more complex form. Simplicity can be achieved when it is known how each person using records desires them to be prepared. They should be simple enough for any one versed in the busi-

ness to understand, but they must be simple enough for the person to whom they are directed to fully understand.

Late information seldom has as much value as it would have if presented at the time when it is needed. Thus, timeliness of information is the fourth requisite. In the use of those records that deal with operations and costs, the value of timeliness is of paramount importance. It is difficult to correct conditions or to change plans to increase effectiveness if actual results of finished performance are not made promptly available. Collection and presentation of record information is frequently delayed because it would cost more to get it out promptly, yet by saving money and delaying the record, its value is so reduced that to have spent more money to insure greater promptness in its presentation would, in fact, have been an economy.

Such elements as the availability and accessibility of records, their transcription and filing, simplification and standardization of the systems, and procedures used in their collection and recording, influence the cost and effectiveness of the records work.

**Managerial Use of Records.**—Figures are always subject to various interpretations, and meanings may be read into figures or deductions made after analysis that seem consistent, yet when these deductions are applied as corrective measures to operations, they may prove to be wrong.

After the necessary records have been determined, the following rules should be observed in recording data, so that the records may serve their purposes best:

1. Define the source from which the data are secured.
2. Define the unit.
3. Consider the purpose for which the data are to be used.
4. Determine and apply a standard method in collecting the data.
5. Determine the degree of accuracy which is necessary, and maintain it.
6. Present the records in simple terms.

From the records and figures which should be available for the use of management, the results secured from the ap-

plication of certain policies, methods, and plans followed in the past are determined, mistakes are corrected, warnings are recognized, changes are made, and present and future plans and expectations are decided upon. From the lowest gang boss, group leader, supervisor, or department head, up to the board of directors, each executive or subordinate has use for records in gauging the efficiency of his own leadership, policies, and plans. Thus, the basis for all managerial activities should be the records and the systematically collected history of the business.

## CHAPTER 4

### MANAGERIAL INTERPRETATION OF THE FINANCIAL STATEMENT

The fundamental basis of all managerial control is adequate data, properly collected and accurately interpreted. Management recognizes the financial statement as the pulse of business operations and through its interpretation management formulates plans, policies and controls for various phases of business activity.

The accuracy with which an interpretation and analysis may be made depends upon the following factors :

- (a) The accuracy of the figures embodied in the statement.
- (b) The classification of the accounts according to accepted practice.
- (c) The figures presented in a manner in which they may be easily compared.
- (d) The items supported with adequate data to permit analysis.
- (e) The statement submitted as soon after the operating period as practicable.
- (f) The interpretation performed by a qualified analyst.

It is impossible even to estimate the importance of records to management in the conduct of any type of business when one considers the obligations which the company owes to the stockholders ; various municipal, state, and federal regulatory bodies, credit rating agencies ; prospective creditors and investors, and the various stock exchanges.

It is obvious, therefore, that all records and accounting procedure must be adequate and accurate in order to serve the needs of a progressive management.

## The Balance Sheet

The financial statement consists of a balance sheet, profit and loss statement and supporting data. The interpretation of the balance sheet (see Figure 48) is as follows:

**Cash in Bank.**—Should represent the amounts on deposit in the bank, subject to immediate withdrawal without notice. All time deposits should be shown separately. In cases where the firm has overdrawn its account at the bank, the overdraft should be shown as a current liability. All issued, and outstanding checks, should be deducted so as to ascertain the actual bank balance.

**Cash on Hand.**—Represents the funds held by the cashier, or others, for the purpose of making immediate cash payments, such as, express charges, materials delivered C.O.D., and various other expenses. The balance sheet should not include such instruments as employees' I. O. U's, or dishonored checks. Management should establish the policy of depositing all incoming funds daily and carrying only a relatively small amount in petty cash.

Special funds received from the sale of company's securities, or otherwise, for special purposes, not subject to general withdrawal, should be deposited in a special account and under no circumstances should such funds be held in the general cash account.

**Accounts Receivable.**—Represents the amount of money owed by customers, or others, for the sale of commodities and should be classified according to their nature, namely:

- (a) Customers' accounts
- (b) Employees' accounts
- (c) Subsidiary companies' accounts

The customers' accounts should be classified further as, "good," "doubtful," and "bad." "Good" accounts are those which may reasonably be expected to be paid; "doubtful" accounts are those which are not paid and from certain credit information

obtained by the company the amount in question may not be realized in full; while "bad" accounts are those which are not paid and, in all probability, will not be paid because the debtor's affairs are in the hands of an assignee or receiver.

For the purpose of showing quick and slow current assets in connection with accounts receivable, it is desirable to formulate a procedure of classifying the accounts as to age, namely: 30, 60, 90, 120 days old.

All "bad" accounts, which are proven to be worthless, should be written off the books. An adequate reserve should be set aside to provide for "bad" accounts based on a percentage of sales, or outstanding accounts, or the company's past experience.

In cases where the company discounts its accounts receivable, it is contingently liable for payment and this contingency should be shown as a liability on the balance sheet.

Analysis of Accounts Receivable will reveal many important and interesting facts:

- (a) Good customers—those to whom it is profitable to sell
- (b) New customers
- (c) Bad customers—those to whom it does not pay to sell
- (d) Volume and type of products sold to individual customers
- (e) Volume and type of products returned by individual customers
- (f) Territorial distribution of products
- (g) Income from individual territories
- (h) Efficiency of salesmen
- (i) Average time elapsed from shipment of products to receipt of funds
- (j) Efficiency of credit and collection policies.

Accounts Receivable should be analyzed in conjunction with an analysis of sales expense so as to derive from it the greatest benefits. For example, one salesman may spend twice as much money as another salesman in order to obtain an account. This fact naturally must be taken into consideration when determining efficiency of salesmen and value of the account to the company.

**Notes Receivable.**—Are of two kinds, those accepted from customers and those from other sources, such as from officers of the company covering a loan. Customers' notes should be shown as a separate item from those received from other sources. In cases where the customer does not pay the notes upon maturity, the note may be renewed, but it is advisable to show notes renewed as a separate item. Notes which are outstanding for one year or more should not be shown as current assets. Notes which have been discounted are contingent liabilities and should be shown as such.

**Inventories.**—Of the manufacturing concern are generally classified as "Raw Materials and Supplies," "Work in Process," and "Finished Stock," and are shown as such on the balance sheet. Raw materials and supplies inventory represent the purchase price and the cost of placing them in the plant. Work in process inventory represents the cost of direct materials, direct labor, and that portion of manufacturing expense which is applicable to the product, while it is in the stages of process. These figures are obtained from the factory ledger in the cost department. The finished stock inventory consists of the completed manufacturing costs of those products which are finished and in the stores, or elsewhere in the plant.

**Valuation of Inventories.**—In considering the values of inventories, one must take into consideration the quantity, the quality, and the cost, and only those materials to which the company has a valid title and which can be considered as inventories. It is considered a conservative practice to evaluate raw materials inventories at market price, or cost, whichever is lower. It must be remembered that no profit is made or loss sustained while the materials are in the stores. The work in process and finished stock inventories should be held at the cost to manufacture the parts or products. Although, to be conservative, these inventories may be held at replacement costs. Inventories pledged for loans should be so shown on the balance sheet, or at least earmarked in some manner to prevent misunderstanding. Materials which have been purchased,



but have not been received, are generally not included in the inventory. Products which have been sold but not shipped are considered part of the inventory. Products which are shipped on consignment are considered part of inventory, but are usually transferred to a consignment account. Inventories should consist only of those materials, supplies, parts, and products which are in a saleable condition. Those products which are unsaleable, or obsolete, should not be included in the inventory.

The true criterion of inventory is value, and not cost. In determining this value, good, sound judgment and concrete experience are the important factors. Under certain conditions, inventories may be properly held at figures below cost where the market price of the raw material has fallen.

Management should establish definite policies concerning inventories and the handling of material requisitions withdrawing materials from stock. The material requisition should be priced by one of two methods, "first-in first-out" method, or "average" whichever is considered the better practice for the particular concern. It is also desirable to formulate policies in connection with the taking of physical inventories and the establishment of the practice of perpetual inventories.

In interpreting the inventory figure on the balance sheet, it should be considered along with the value of sales for that period, and the length of time required to manufacture a product from raw material to completion. Assume that the sales amount to \$2,000,000 for a year and the product requires twenty-one days to manufacture. The balance sheet shows an inventory of \$950,000. One may well assume, therefore, that something is wrong.

Management should formulate inventory ratios consistent with volume of sales and economic conditions. When inventory figures fluctuate from normal, they should be investigated, even though payables have increased and cash decreased. Increases in inventories may be warranted in view of the fact that the purchasing agent may have taken advantage of market prices where inevitable price increases are forecasted.

$$\begin{aligned} \text{(a) Inventory Position} &= \frac{\text{Inventory}}{\text{Current Assets}} \\ \text{(b) Inventory Turnover} &= \frac{\text{Cost of Sales}}{\text{Average Inventory}} \end{aligned}$$

**Investment.**—Investments, or securities, represent an item frequently included in the assets of the balance sheet, which may be either permanent or temporary in nature. If the investment represents securities held for the purpose of controlling the activities of other companies, then it should be considered a fixed asset. Surplus funds invested in securities constitute a current asset and are considered temporary investments.

Investments should be held on the ledger at cost, which is the amount of money paid for them, plus the brokerage commission. In a case where the market value of the securities has declined, an adequate reserve should be established to provide for possible loss. Where the cost price includes accrued interest, or dividends, these items should be set up in a separate account. It is of course desirable, where possible, to hold stock on the ledger at its actual worth, but only under extremely rare occasions should the stock be held at its par value.

Some authorities recommend the revaluation of securities at periodic intervals. This practice may be desirable but it is questionable if one can determine their actual worth, except at current market price which is not a true valuation. In cases where bonds are purchased at a premium, the premium should be liquidated against the interest income received from the bond, over the period of its life. In cases where the investment account represents foreign securities, it is well to keep in mind the problems which may arise due to foreign exchange fluctuations.

The investment account should be closely watched and the securities held should be checked with market prices so that large fluctuations in value may be adequately provided for.

**Patents.**—In cases where patents are purchased, they are set up on the books at the purchase price and written off over the life of the patent; or, to be more conservative, a patent may be written off before the expiration of the patent right. Where

the invention is the result of experimental work on the part of the company, it is proper to set it up on the books of the company by capitalizing all the costs incurred in connection with the experiment and development work, plus the costs of procuring the patent rights.

**Deferred Assets.**—This item usually represents expenditures which have been incurred for the benefit of later periods and may be classified as deferred charges to expense and deferred charges to profit. Deferred charges to expense usually consist of prepayments for services, such as prepaid advertising, insurance premiums, taxes, prepaid transportation, and prepaid interest. The portion of these expenses which apply to the current period should be charged to costs of that particular period, while that portion of it which is applicable to a later period should be held as a deferred asset. A deferred charge to profit is generally considered a capitalized item of expense which may be written off to profit, or surplus, over a period of many years, such as organization expense. Some accountants observe the policy of holding inventories of operating and office supplies as deferred charges to expense, because these inventory items are not held for sale and will eventually be absorbed in cost of operations as expense.

Experimental and development expenses should be shown as deferred charges to expense and written off during the periods benefited, but if the experimental work is in the nature of developing equipment or machines, etc., for manufacturing operations, then the cost should be capitalized and set up on the equipment records.

**Land.**—The land account should represent the actual cost of the property plus the incidental expenses necessary to its acquisition. All liens against the property should be clearly shown on the balance sheet. The cost of all improvements of a permanent nature, which are necessary to make the land suitable for purposes of business, such as leveling, draining or filling-in, should be shown in a separate account. As a general rule, land does not depreciate, but when this does occur, it is desirable to reflect these conditions on the balance sheet. Land held for

investment purposes should be carried in a separate account. All carrying charges may be added to the cost of the land, but conservative practice requires a reserve to be established equal to these additional expenses in order to cover the loss in case the capitalized expenses are not realized at the time of sale.

**Buildings.**—The buildings account should represent the cost of acquiring, or erecting, the buildings. The cost includes materials, labor, supervision, architects' fees for drawings and specifications, cost of excavating, foundations, water mains, and other similar items. All costs of financing the building operations are considered legitimate charges to the cost of buildings up to the time of occupancy.

The cost of making additions to buildings should be capitalized, while the cost of repairs should be considered expense and thus charged to the cost of operations. In the case of replacement of buildings, the general practice is to write off the old and capitalize the new; or capitalize the difference in cost between the old and the new building.

**Reserve for Depreciation of Buildings.**—Factory buildings are subject to depreciation; the rate depending upon nature and structure of the building (see Chapter 8). The cost of depreciation should be charged to the cost of manufacturing the products and an equal reserve set up on the general books. The balance sheet should show the amount of the reserve which has been established to provide for the depreciation. The difference between the buildings account and the depreciation reserve account represents the present value of the buildings for book purposes.

Reserve for depreciation is established to provide for replacements or renewals of plant, equipment, and machinery.

**Equipment.**—The equipments accounts represents the cost of all machinery and equipment used in the operation of the business and is usually divided into three classifications:

- (a) Plant Equipment
- (b) Office Equipment
- (c) Transportation Equipment

Each item of equipment is set up on an individual card record, or ledger sheet (see page 145) and the total cost of the equipment is carried on the general ledger in the equipment account and thus it is shown on the balance sheet.

The valuation of equipment is based on final cost, that is, the purchase price, plus transportation inward and cost of installation.

Office equipment, usually called furniture and fixtures on the balance sheet, is handled in a similar manner to that above mentioned. It consists of office furniture, adding machines, lighting fixtures, partitions, etc.

Transportation equipment consists of trucks and automobiles used for traffic activities and should be depreciated in a relatively short period of time. (See Chapter 24.)

If special machines are manufactured by the concern, they should be also capitalized at total cost, or the amount of money expended to develop, produce, and put them into operation.

To conform to conservative practice, some concerns hold their equipment at the nominal value of one dollar, but it is questionable if this practice shows the correct financial condition, or the true earnings of the concern.

**Reserve for Depreciation of Equipment.**—All equipment is subject to depreciation, depending upon its nature and type of work performed. (See Chapter 8.) Where a reserve appears on the balance sheet, it is difficult to determine whether or not the reserve is adequate because it is impossible to establish the age of the equipment. However, by studying the detailed profit and loss statement, one may roughly estimate the adequacy by an examination of the amount of depreciation charged to cost of the product, for the particular period in question.

The depreciation reserve should not be merged with other reserves, or with surplus, as is sometimes found on published balance sheets. They should be shown separately on the asset side of the balance sheet and under the assets to which they refer.

**Liabilities.**—The term liability in connection with the balance sheet is somewhat misleading, because proprietor accounts are included. The capital account, strictly speaking, is not a liability but rather a valuation account.

The liability side of the balance sheet consists of two classifications, current and fixed liabilities. Current liabilities are those which must be liquidated within one year, or less, and represent funds which are invested in the business on a current or short-term basis. Fixed liabilities are those which have longer than one year to run and are usually considered long-term obligations. Fixed liabilities are known also as capital liabilities.

The majority of liabilities are contractual in nature and thus they are fixed in amount, making the problem of their tabulation much less complicated than asset valuation.

**Accounts Payable.**—The accounts payable represent the amount due to vendors for the purchase of goods, or property, or money owed for work performed in the ordinary course of business. These accounts are generally valued at the gross amount; the cash discount on purchases being considered as "other income" and therefore not deducted from the accounts payable.

**Notes Payable.**—This account represents the value of promissory notes given to creditors and these obligations usually mature in 30, 60, 90, or 120 days. The amount of outstanding notes should be watched carefully and payments should be made at maturity. These notes usually bear interest and thus the interest accrued must be shown on the balance sheet.

A balance sheet revealing a large amount of notes payable usually means a definite financial weakness.

**Bonds.**—All bonds payable should appear on the balance sheet as a liability and should show the nature of the bond and date of maturity; for example, first mortgage 5 per cent, maturing 2013.

**Accrued Liabilities.**—These consist of such accounts as accrued wages, accrued interest, accrued taxes, accrued rent,

accrued royalties, and dividends declared. These amounts represent monies owed but not yet due at the date of the balance sheet.

**Contingent Liabilities.**—The balance sheet should show all contingent liabilities, such as notes receivable discounted, accommodation indorsed notes, accounts receivable sold, or probable legal judgments against the concern. The majority of these contingent liabilities do not materialize as actual liabilities. However, they should be clearly indicated at full face value on the balance sheet.

**Reserves.**—Certain accounts which appear on the balance sheet and known as reserve accounts are set up with the intention of setting aside a portion of the profits or surplus for a definite purpose, or to meet contingencies. Reserve accounts are classified under three specific categories, namely:

- (a) Valuation reserves
- (b) Liability reserves
- (c) Surplus reserves

A valuation reserve is credited for the purpose of showing the true or estimated value of an asset. For example, in the accounts receivable ledger certain accounts may be deemed improbable of collection and while they are not yet considered a bad debt, a reserve should be established for doubtful accounts so that the accounts receivable item on the balance sheet will represent more or less a true value. Reserves for depreciation, or depletion, serve the same purpose and are thus considered valuation reserves.

Liability reserves are credited when there is an uncertainty as to the amount of a liability, or when certain contingencies are pending. For example, the liability of taxation is seldom definite at the beginning of a year. City taxes are dependent on the assessed valuation of the plant. Federal income taxes are dependent upon yearly earnings. Thus an income tax reserve should be set up each month and shown on the balance sheet. Where a manufacturer guarantees his product for a period of time, with the understanding that all defective or

worn parts will be replaced at his expense during the period of the guarantee, a contingent reserve should be set up for sales of this nature.

Surplus reserves are created for the purpose of withholding a portion of surplus from or restricting its distribution to, stockholders, during the life of certain indebtedness, or for the purpose of plant expansion, or for the purpose of purchasing new equipment. Certain bond and stock issues require the establishment of a reserve to insure payment of these obligations and reserves are set up out of surplus. When the obligation is paid the reserves revert to surplus.

The board of directors may set aside a certain portion of surplus in the form of a reserve to construct a new and additional building. In cases where appreciation of fixed assets appear on the balance sheet, the contra-liability entry should be shown as a surplus reserve.

**Capital Stock and Surplus.**—The excess of assets over the liabilities is represented by capital stock and surplus accounts. In general terms, "the amount assigned to capital stock represents the amount of capital which is required by law to be retained permanently in the business as a fund for the protection of creditors and not subject to dividend disbursements to stockholders, while surplus is the excess of the total value of the assets over liabilities to creditors and capital stock and represents the amount which is subject to withdrawal from the business in the shape of dividends to stockholders. There are, however, many exceptions to this general rule."<sup>1</sup>

The corporation's proprietorship consists of the following: (1) the capital stock outstanding; (2) the surplus; and (3) surplus reserves.

The various classes of stock should be shown on the balance sheet separately. Stock held as treasury stock should be shown as such.

The surplus account should be composed of those profits only which have actually been realized and not include expected profits.

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<sup>1</sup> Cost and Production Handbook, p. 13.



## Statement of Income and Profit and Loss

The financial statement consists of the balance sheet, the statement of income and profit and loss, and the supporting data of that statement. Many business men seem content to analyze only the balance sheet but a true picture of operations cannot be obtained unless the statement of income and profit and loss is also carefully analyzed. (See Figure 47.)

This statement is usually known as the profit and loss statement, or the operating statement, and is the final summary of operations for a given or specified period of time.

The income from business activity is derived from the sale of products or service, which income is broadly divided into operating income and non-operating income.

The methods used in analyzing and interpreting the profit and loss statement may be illustrated by utilizing the simple statement shown in Figure 47 and briefly discussing each of its items.

**Gross Sales.**—This item represents, at sales price, all products or services sold, whether for cash or credit, for the specific accounting period. The supporting schedule, an analysis of the accounts receivable (see page 63), will show the amount of the accounts outstanding at the end of the particular period under consideration. The sales account should be credited with bona fide sales of products.

**Sales Returns.**—This represents the value of products returned by the customer for which he receives credit. This should be charged to the sales return account and credited to the customer's account. The amount of sales returns is deducted from the net income from sales, which gives gross profit on sales.

**Sales Expense.**—This represents the cost of selling the product and includes such items as (see Chapter 25) salesmen's salaries, travelling expenses, advertising expenses, etc. These items should be classified and shown on the supporting schedule.

**Administrative Expense.**—This represents the cost of general administrative expenses and includes items, such as (see Chapter 28) officers' salaries, office expenses, etc.

The amount of sales and administrative expenses is deducted from gross profit on sales, giving the net income from operations.

**Other Income.**—This represents the miscellaneous income from sources other than the sale of products, such as, interest on bonds owned, dividends on stock owned, cash discount on purchases, and from many other sources. Again, these amounts should be shown separately under their specific classification. The amount should be added to net income from operations, which will give the net profit or loss for the period, which, in turn, is transferred to the surplus account.

Each item of the profit and loss statement should be supported by an individual schedule showing the detail. It is also desirable to have comparative statements of profit and loss, so that one month's operations may be readily compared with another, and one year with another year.

## CHAPTER 5

### MANAGERIAL CONTROL OF OPERATIONS THROUGH ACCOUNTS

**Phases of Management.**—The administration of business under modern conditions and technical progress is a complex problem which can be solved only by a study of the various elements of which business is composed. The analysis should consist of determining the various functions and then constructing an organization around these functions which will produce the desired results; keeping in mind the scientific principles of organization laid down in Chapter 2.

Management is divided into three major activities, that of administration, which is policy formation and general planning; execution, which is the operating phase, and staff, which is the advisory phase. In the corporate form of business organization the president is the chief administrative officer, while the general manager is the chief executive officer. The work of the company's economist and legal counsel is usually considered as staff activity. The president is responsible for company administration. Planning, directing, and controlling the internal operations are the major work of the chief executive and, therefore, he must have adequate facilities and be vested with absolute authority to discharge his required responsibilities.

**Accounting as a Tool of Management.**—The accounting system is one of the most important tools which management has at its disposal, as most managerial decisions are formulated on the basis of records. In order to explain the bases of managerial direction and control, it is proposed to set up an organization chart, Figure 6, and point out the physical movement of materials, or documents, within the organization and to correlate these physical activities with the records on the books

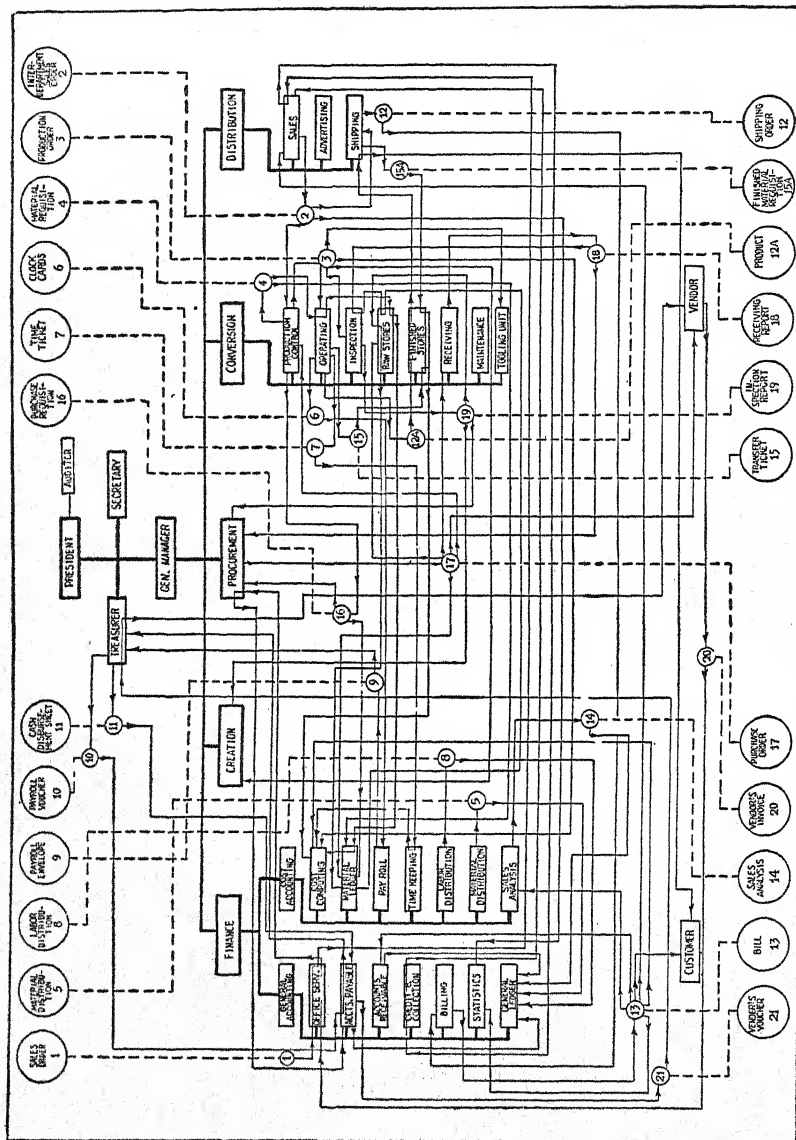


Figure 6. Relationship of Activities to Managerial Control. (See large chart.)

of accounts. The starting point may be any activity in the operating cycle, but for convenience the sales phase has been selected. One may start at any point within the production cycle and trace any factors through the complex structure of organization, back to its origin. In this procedure, certain assumptions must be made for the sake of clarity. The first assumption is that the sales order in question is number one and that there are no raw materials or finished products on hand. The second assumption<sup>1</sup> is that a customer sends in an order by mail for ten units of standard product. From this point, it is interesting to follow the order through its complex ramifications of manufacture, the records involved, the ultimate shipment, and the billing of the order to the customer who purchased these products. Naturally, it is conceded that this procedure is not complete for all types of manufacturing concerns but it serves as an illustration of the principles of control through accounts, which may be modified, or expanded, to suit any specific case and it is designed, especially, for the purpose of correlating activity with records of that activity.

**Sales Order.**—The incoming customer's letter with an order requesting 10 products (designated as number 1) is received by the office manager's division, mail section, where it is opened by the mail clerk and forwarded to the sales department direct.

Upon receipt by the sales manager, it is sent to the "credit division" for the purpose of determining the credit standing of the customer, and after approval by the credit manager it is returned to the sales department, where the required number of copies of the inter-departmental sales order (designated as number 2) are made and forwarded to the following activities:

- (a) Copy to Production Control Division
- (b) Copy to Shipping Division
- (c) Copy to Statistical Division (Information as to orders received)
- (d) Copy to Sales Division (Record, file)

In cases where the product is in finished stores, the shipping division uses its copy of the inter-departmental sales order (2)

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<sup>1</sup> The student is advised to follow each step carefully on the chart, Figure 6.

as authority to withdraw the product for shipment. Where the product has to be manufactured, as in this case, the shipping department's copy of the order is used to advise them that the product must be shipped on a certain date and it is that department's responsibility to obtain the product prior to the date of shipment.

<b>MATERIAL, EQUIPMENT AND SUPPLIES ORDER (4)</b>							
DELIVER TO _____ DEPARTMENT				DATE _____			
ORDER ONE ITEM ONLY ON THIS TICKET				TICKET NO. _____			
				CHARGE TO _____			
				<div style="display: flex; align-items: center;"> <span style="font-size: 2em; margin-right: 5px;">{</span> <div style="margin-left: 5px;"> PART NO. _____  SHOP ORDER NO. _____  EXPENSE NO. _____ </div> </div>			
FOR ORDERING DEPARTMENT				FOR STOCKROOM		FOR COST	
ORDER NO.	QUANTITY	UNIT	MATERIAL	QUANTITY DELIVERED	BALANCE ON HAND	PRICE	EXTENSION
FOREMAN _____				DELIVERED BY: _____		ENTERED IN CONTROL LEDGER BY _____	
DEPT. _____							

Figure 7. Material Requisition

**Production Order.**—The production control unit prepares and issues the production order (3) in six copies, or as many more copies as may be required depending upon the type of industry and organization units affected. A copy is forwarded to each of the following activities:

- (a) Operating unit
- (b) Cost unit
- (c) Tooling unit
- (d) Inspection unit
- (e) Engineering unit
- (f) Production control unit's file

The operating unit's copy is accompanied by the necessary engineering blue prints, specifications and material requisitions

(4) authorizing the withdrawal of raw materials from stores. The cost unit's copy is filed in the factory ledger along with the appropriate cost sheet, upon which costs are compiled. The tooling unit uses its copy for the purpose of accumulating the necessary tooling for the job, and upon authorized requisition from the operating foreman, delivers the required tooling. The three other copies are utilized for record purposes, by the respective units.

<b>Original Shortage Req. on</b>		<b>STOCK (4)</b>		REQ. NO. _____	
DATE	PRODUCTION ORDER NO.	DRAW NO. AND NAME	PIECES PER ASSEMBLY		
FOR DEPARTMENT			STOCK ROOM NO.		
QUAN. ORD.	QUAN. DEL.	NAME OF ARTICLE	PRICE	AMOUNT	
RECEIVED	19	FOREMAN	TOTAL		

Figure 8. Stock Requisition

**The Material Requisition.**—<sup>2</sup> The operating unit delivers its signed material requisitions (4) to the material handling unit, which, in turn, procures the materials and delivers them to the operating unit. The storeskeeper deducts the amounts delivered from the respective bin tag and forwards the requisition to the stores ledger clerk, who is under the functional control of the cost unit and line control of the production control unit. The ledger clerk prices the requisition (4), using first-in first-out, or average method, and makes the necessary extensions and deducts the quantity and value from the quantity and

<sup>2</sup> The purchasing procedure required to place the raw materials in the storesroom will be discussed on page 87.

value balances on the respective ledger sheets. These requisitions are then forwarded to the cost unit, where they are posted on the cost sheet under the stated production order. Material requisitions (4) form the basis for material costs.

At the end of each month a material distribution sheet (5) is compiled for the purpose of making the necessary journal entry, crediting materials and charging the various "work-in-process," maintenance, and other orders.

EMPLOYEE NO.	DAY WORK TIME TICKET (7)							DEPT. NO.
NAME								
WEEK ENDING	SUN.	MON.	TUES.	WED.	THUR.	FRID.	SAT.	TOTAL
ACCOUNT NO.	DESCRIPTION OF WORK						HRS.	EQUIP. NO.
APPROVED BY			CHECKED BY					
FOREMAN			ACCOUNTING DEPT.					
HOURS	HOURLY RATE	TOTAL	EXTRA RATE		MISC	AMOUNT		

Figure 9. Time Ticket

**The Clock Card and Time Ticket.**—The foreman of the operating unit delivers the materials, with necessary instruction sheets, to the machine designated by the production control unit and assigns an operator to perform the work. Each operator is required to punch a time clock, when he enters the plant or leaves it, which gives a record of the amount of time spent. The clock cards (6) are collected weekly and sent to the payroll unit for the purposes of determining the amount of wages earned by workers. The clock card (see page 178) forms the basis for determining payroll, with the exception of the pay for those operators employed on a piece rate scale. The departmental timekeeper, under the line control of the cost unit, is





account and crediting accounts payable. The voucher, when properly signed, is returned to the treasurer, who makes out a cash disbursement sheet (11), recording the voucher (10), which is a charge to accounts payable and credit to cash. The treasurer obtains the money from the bank, on the voucher (10), and places the designated amount in each pay envelope (9) and distributes the envelopes to the respective workers.

EMPLOYEE'S NO.	PIECE WORK TICKET						DEPT. NO.
	NAME						
MATERIAL BASIS	DATE		START		FINISH		
REJECTS WORKMANSHIP	SHOP ORDER		PRODUCTION ORDER		MACHINE NO.		NO. MACHINE
MATERIAL	PART NO.		PART NAME				
CREDIT TO BE REWORKED	ORDER NO.		OPER. NAME				
NO CREDIT TO BE REWORKED	NEXT OPERATION						TO DEPT.
ACCEPTED	INSPECTOR		COUNTER		FOREMAN		ACCOUNTING
QUANTITY PAID FOR	PAYROLL DEPARTMENT						
	STANDARD PER HOUR	CLOCK HRS.	PAY HOURS	HOURLY RATE	TOTAL	GUARANTEE	AMOUNT

Figure 11. Piece Work Ticket

The cash disbursement sheets are journalized at the end of each month. This completes the cycle of accounting record control of labor and labor costs, through the time tickets and clock cards to the general ledger by means of journal entries.

**The Finished Product.**—At this stage the records of material and labor costs are in the factory ledger and also in the “work-in-process” account of the general ledger. The products represented by the materials and labor are in process in the factory and when the job for ten products is completed, it is turned over to finished stock, from where it is withdrawn, on authority of the inter-departmental sales order by the shipping unit.

**The Billing Procedure.**—The products are shipped to the customer and a copy of the shipping order (12) is sent to the billing unit, which prepares and issues the bill (13) with as many copies as are necessary for control and record purposes. The following number of copies is essential:

- (a) Original bill sent to customer
- (b) Copy to accounts receivable unit (13)
- (c) Copy to sales unit
- (d) Copy to sales analysis unit
- (e) Copy to cost unit
- (f) Copy to statistical unit
- (g) Copy for billing unit file.

It is assumed that there are three ledgers in the accounts receivable unit, one containing all customers' names from A to G;

<b>ORIGINAL</b>	
<b>PIECE WORK TICKET</b>	
<b>NAME</b>	<b>DATE</b>
<b>DRAW. NO.</b>	<b>NAME OF PIECE</b>
<b>OPERATION</b>	<b>OPER. SYMBOL</b>
<b>ACTUAL TIME PER PIECE "T"—</b>	<b>RAISED TO REDUCED FROM</b>
<b>REASON</b>	
<b>P. W. PRICE PER HUNDRED</b>	
<b>MACHINE</b>	<b>DEPARTMENT</b>
<b>ALLOWANCE "A"—</b>	<b>FOREMAN</b>
<b>RATE "R"—</b>	<b>APPROVED</b>

Figure 12. Another Form of Piece Work Ticket

second, all names from H to N; third, all names from O to Z. The copy of the bill (13) is recorded in its respective account on the accounts receivable ledger. The customer sends in his check covering the amount of the bill, which is a credit to his account on the accounts receivable ledger. The check is recorded on the cash receipt sheets and sent to the treasurer for



deposit; the cash receipt sheets are journalized at the end of each month, charging the Cash Account and crediting Accounts Receivable.

**The Sales Analysis.**—The analysis of sales (14) is compiled by the cost unit (see Figure 14) for several purposes; (a) to determine profit, or loss on each type of product; (b) to check on the accounts receivable ledger; (c) to check shipments made; (d) to formulate a journal entry, charging accounts receivable on the general ledger and crediting sales. A similar sheet is compiled for sales returns and journalized in a like manner; charging sales and crediting accounts receivable on the general ledger.

It should be noted that on the sales analysis the customers' invoices are recorded numerically, while in the accounts receivable ledger they are recorded alphabetically.

**Cost of Sales.**—Upon completion of the job by the operating unit, it is turned over to finished stock on a transfer ticket (15) and then withdrawn by the shipping unit on a finished stock requisition, both of these tickets (the former bearing the production order number and the latter bearing the sales order number) are sent to the cost unit, where they act as authorization to transfer the costs of the product to finished stock and thence to shipping. The cost unit compiles the costs of the product on the production order cost sheet, applying the manufacturing expense to the already collected material and labor costs, and transfers the total cost to its cost copy of the customer's invoice. The cost copy of each customer's invoice is now listed numerically on a large distribution sheet similar to the sales analysis (with the omission of the accounts receivable ledger columns). The quantity and cost of each class of product shown on the invoice are also listed on the distribution sheet. This establishes a cost for each sale on the distribution sheet which is known as the "cost of sales distribution sheet" and is journalized at the end of each month, charging cost of sales and crediting "finished stock," as the case may be. The difference between the sales account and the cost of sales account in the general ledger represents the gross profit, or loss.



**Controlling the Supply of Raw Materials.**—The other phase of the cycle of controlling operations deals with the procurement of the necessary materials and supplies. The request for materials originates in the materials ledger unit, through the production control unit. When the supply of a particular raw material is reduced to a certain designated quantity in the stores, the ledger clerk notifies the clerk of the production control unit, who investigates the matter and issues a purchase requisition (16) and provides as many copies as are necessary:

- (a) Original to purchasing unit
- (b) Copy to materials ledger unit
- (c) Copy for file

The original copy, with necessary engineering blue prints and specifications, is forwarded to the purchasing unit, where a purchase order (17) is issued and the required copies are forwarded to the various activities, as follows:

- (a) Original to vendor
- (b) Copy to materials ledger unit
- (c) Copy to receiving unit
- (d) Copy to stores
- (e) Copy to production control unit
- (f) Copy to purchasing unit's file

Records of the purchase order are placed in the materials ledger, showing that the material has been ordered.

**Receiving of Materials.**—Upon receipt of the material from the vendor, the receiving unit issues a receiving report (18); one copy is sent to the purchasing unit and another copy to the inspection unit, and still a third copy attached to the material itself. Where the material is of such a nature that it requires inspection, an inspector is assigned by the inspection unit to examine it. After the inspection is made, an inspection report (19) is issued; one copy of which is sent to the engineering unit, one copy to the purchasing unit, and a copy attached to the material. The material is delivered to the stores, along with a copy of the receiving report (18) and a copy of the inspection report (19).

It is the responsibility of the storeskeeper to count the material and record the receipt on the respective bin tag and forward the receiving report and inspection report to the materials ledger clerk, who records the receipt of the material in his ledger.

**Payment of Bill.**—The vendor's bill is received and forwarded to the purchasing unit, where it is checked against the purchase order, receiving report, and inspection report. If it is correct, the purchasing agent certifies the accuracy of the bill and sends it to the accounting unit for payment. The accounts payable unit prepares and issues a voucher (2) in duplicate in favor of the vendor for the amount of the bill. The original voucher (which is in the form of a bank check) is forwarded to the treasurer who signs and records it on the cash disbursement sheet and forwards it to the vendor.

The duplicate voucher, attached permanently to the vendor's bill, is recorded in the accounts payable ledger and, or, the purchases analysis. Where it is possible to make payment of all bills within the discount period, the accounts payable ledger may be partially abandoned and a purchase analysis used instead (see Figure 15). The cash disbursement sheet is used to record the payment of the bill on the purchase analysis. All unpaid items on the purchase analysis are recorded in an accounts payable ledger, if desired.

The purchase analysis is journalized at the end of the month, charging the various accounts, such as materials, supplies, manufacturing expense, labor, freight, equipment, tools, etc., and crediting accounts payable on the general ledger.

The quantity of material received is already recorded on the materials ledger and the original vendor's bill is utilized to record the cost of those materials in the materials ledger.

Management is able to control operations through accounts and records by this simple system.



## CHAPTER 6

### MANAGERIAL CONTROL THROUGH CLASSIFICATION

**Purposes of Classification.**—To control adequately the various phases of business activity, it is essential to classify all elements which are an integral part of business operations. The majority of manufacturing concerns have devised various methods of grouping activities on the basis of functionalization and establishing departments so as to obtain control of the operating facilities. But, in order to expand that control through the medium of accounting, a further grouping of materials, product, equipment, and all elements of manufacturing must take place. This can be accomplished by a careful preliminary analysis and the intelligent planning of the proposed manufacturing activities. Thus an efficient system of classification can be established which can be subjected to almost unlimited expansion.

**Definition:** Industrial classification means the grouping and arranging of all items under a common designation according to their characteristics, similarities, or relationships.

Thus, classification symbols become the common management language of industry adopted for the purpose of definite identity, clarity and brevity.

The primary functions of all manufacturing concerns are finance, creation, procurement, conversion, and distribution. This in itself is a classification of activity and these functions are further subdivided into minor classified activities known as divisions, which, in turn, are subdivided into classified activities known as sections. Management sets up this classification so as to determine efficiency of operation through the medium of costs. It is impossible to establish comparisons of costs unless some system of classification is adopted.

It is apparent that in the entire accounting and recording system an adequate method of classification must be constructed and maintained in order to control raw materials, work-in-process, finished stock, and all elements of manufacturing activity.

**Principles of Classification.**—Classification is accomplished by designating names, or symbols, such as numerical figures, alphabetical letters or mathematical signs to represent a specific item.

“A symbol should be exclusive and should completely differentiate the item it represents from every other item in the system.

A symbol should indicate by its form the class and principal subclasses in which the item represented belongs.

A component or designation of a symbol should include all that follow it and limit all that precedes it.

The position of each component of a symbol has significance; first component may represent general class; second, the principal subclass; and third, the division of the subclass.”<sup>1</sup>

**Classification of Departments.**—The unification of operating activity and the determination of the efficiency of the various functional groups can be greatly facilitated by classifying these activities according to the nature of the work performed. This, in turn, will create nuclei for collecting cost data and distributing the various items of manufacturing, selling and administrative expenses. There are six general classifications of departmental activity which are common to most of our modern manufacturing concerns.

1. **OPERATING DEPARTMENTS.** This classification represents those departments which actually participate in the manufacture of the product.

2. **SERVICE DEPARTMENTS.** This classification represents those departments which are accessory to the producing departments inasmuch as they facilitate the manufacture of the product by rendering essential and varied services to the producing departments.

<sup>1</sup> Cost and Production Handbook, The Ronald Press Co., N. Y., 1934, p. 1474.

3. **FACTORY ADMINISTRATIVE DEPARTMENTS.** This classification represents those departments which are primarily engaged in planning, directing, aiding, and controlling both the producing and service departments.

4. **TRAFFIC DEPARTMENTS.** This classification represents those departments which are engaged in external transportation.

5. **COMMERCIAL DEPARTMENTS.** This classification represents those departments which are actually engaged in the distribution of the product.

6. **GENERAL ADMINISTRATIVE DEPARTMENTS.** This classification represents those departments that are administrative in nature and serve the entire business.

The medium size manufacturing concern, for example, consists of the following departments. The number preceding the name of the department designates the classification symbol of that particular department and is used on requisitions, time tickets, and various other forms to identify the department in question instead of writing the name.

It is easy to see how a system of this nature will aid the accounting and cost accounting procedures. For example, the cost clerk receives a material requisition or time ticket bearing the number 1000. He knows immediately that the charge is to be made against the punch press department.

#### OPERATING DEPARTMENTS

- 1000 Punch Press Department
- 1001 Lathe Department
- 1002 Automatic Screw Department
- 1003 Milling Machine Department
- 1004 Planer Department
- 1005 Drilling Department
- 1006 Plating Department
- 1007 Polishing Department
- 1008 Pattern Department
- 1009 Core Department
- 1010 Iron Foundry
- 1011 Brass Foundry
- 1012 Forge Department

1013 Annealing Department

1014 Assembly Department

#### SERVICE DEPARTMENTS

1100 Tooling Department

1101 Maintenance and Repair Department

1102 Inspection Department

1103 Production Control Department

1104 Power Plant

1105 Receiving Department

1106 Raw Material Stores

1107 Work-in-Process Stores

1108 Finished Product Stores

#### FACTORY ADMINISTRATION DEPARTMENTS

1200 Engineering Department

1201 Chemical Laboratory

1202 Employment Department

1203 Purchasing Department

1204 Cost Department

1205 Factory Administration

1300 Traffic Department

#### COMMERCIAL DEPARTMENTS

1400 Sales Department

1401 Advertising Department

1402 Shipping Department

#### GENERAL ADMINISTRATIVE DEPARTMENTS

1500 Comptroller's Department

1501 Treasurer's Department

1502 Audit Department

1503 Legal Department

1504 Industrial Relations Department

1505 General Administrative Department

The cost of operating the departments in the 1000, 1100, and 1200 series is distributed to manufacturing costs; expenses involved in operating those departments in the 1300 series should be prorated between the purchasing department and the sales department on some predetermined basis, provided, the traffic function serves both the purchasing and sales activities.

The expenses involved in operating the departments in the 1400 and 1500 series are charged to cost to make and sell.

**Classification of Accounts.**—The purpose of accounting is to record all business transactions in a systematic way so as to provide management with reliable data upon which may be formulated plans and policies for the successful direction, operation, and control of the business enterprise.

Accounts present the existing conditions and the changes which take place from time to time. Some of these accounts are classified as assets and others are classified as liabilities and net worth. A classification of accounts is a definite arrangement of these accounts based upon the relation that one bears to the other.

### **Classification of Balance Sheet Accounts.—**

#### **PRIMARY CLASSIFICATION**

##### **ASSETS**

1. Cash, Securities, and Receivables
2. Materials, Work in Process, Finished Product
3. Land, Plant, and Buildings
4. Prepaid, Deferred, and Other Assets
5. Patents and Good-Will

##### **LIABILITIES**

6. Current Liabilities
7. Fixed Liabilities, Capital and Surplus

#### **SECONDARY CLASSIFICATION**

11. Cash in Bank
12. Petty Cash
13. Securities
14. Accounts Receivable
15. Notes Receivable

##### **.1 RESERVE**

21. Raw Materials
22. Supplies
23. Work in Process
24. Finished Products
31. Land

- 32. Buildings
- 33. Buildings under Construction
- 34. Machinery and Equipment
- 35. Machinery and Equipment under Construction
- 36. Drawings
- 37. Patterns
- 38. Furniture and Fixtures
- 39. Automobiles

.3 RESERVE FOR DEPRECIATION

- 41. Salaries and Wages Paid in Advance
- 42. Rent Prepaid
- 43. Taxes Prepaid
- 44. Insurance Prepaid
- 45. Freight, Express, and Cartage
- 46. Prepaid Expenses
- 51. Patents
- 52. Copyrights
- 53. Trade-Marks
- 54. Good-Will
- 61. Accounts Payable
- 62. Notes Payable
- 63. Labor Accrued
- 64. Interest Accrued
- 65. Taxes Accrued
- 66. Dividends Payable
- 71. Funded Debt
- 72. Preferred Capital Stock
- 73. Common Capital Stock
- 74. General Reserves
- 75. Earned Surplus
- 76. Capital Surplus

**Classification of General Ledger Operating Accounts.—**

PRIMARY CLASSIFICATION

- 2. Work in Process
- 8. Sales and Sales Expense
- 9. Sundry Income, Income Tax, and Profit and Loss

SECONDARY CLASSIFICATION

- 25. Manufacturing Expense
- 26. Manufacturing Expense Absorbed in Cost

81. Sales
82. Sales Returns
83. Sales Allowance
84. Excise and Sales Taxes
85. Cost of Sales
86. Shipping Expense
87. Selling Expense
88. Warehousing Expense
89. Administrative Expense
91. Sales of Scrap
92. Cash Discount on Purchases
93. Dividends Received
94. Royalties Received
95. Provision for Income Tax
96. Profit and Loss

A further refinement of this classification may be accomplished by using the decimal system. For instance, an account for salesmen's salaries may be set up under 87.01 and salesmen's commissions account might be 87.02, and so on indefinitely. It is obvious that this classification of accounts may be adapted to any form of manufacturing concern by either increasing or decreasing the number of accounts to those required for control.

**Classification of Manufacturing Expense.**—Without an adequate classification of some type, it becomes difficult, if not impossible, to obtain departmental, production order, cost center, job, or other costs, although the total cost of production can be obtained and a unit cost may be secured. The major uses of costs data would be nullified, that is, the operating efficiency of an activity would never be known, unless cost data are available so that the costs of past operations can be compared with those of the present.

The classification of manufacturing expense not only simplifies the technique of costing, but makes it possible to distribute the various elements of cost to the various jobs, cost centers or departments. The classification of all manufacturing costs is not only desirable but essential to management for the purposes of planning, directing, and controlling each individual phase of business activity.

**Basis for Classification.**—The cost to manufacture any product is composed of the cost of three items, namely, material, labor, and expense. The first two elements are measurable but the third remains doubtful in regard to its measurability. Manufacturing expense, variously known as burden, operating costs, or overhead, includes all expenses incurred in the manufacture of the product other than the cost of direct material and direct labor. It must be applied to the cost of the product in some direct or indirect manner in order to determine the complete manufacturing cost of that product. It is, therefore, necessary to classify each item of expense according to its use, nature, characteristic, or its consumption in relation to manufacturing processes, operations, units of activity, or departments. The entire classification should conform to the organization structure. This enables management to compare the items of expense in each class with those in the same class for various periods of time and also to determine an equitable method for distributing the items of manufacturing expense to the cost of the product.

**Direct Charges Sometimes Impracticable.**—Direct material cost is the cost of all material which can be measured which forms an integral part of the product and which can be charged directly to the cost of that product.

In some cases the quantity of certain materials used in production is so small that it is not worth while from a practical accounting standpoint to make a direct material charge of such items. In such cases, this direct material is charged into manufacturing expense and is ultimately charged to the product. For example, the few feet of thread used in sewing the band on a hat is of so little value that it would probably cost more to determine its exact value than the thread itself is worth. This item is, therefore, charged to manufacturing expense. Such items are often classified as "incidental materials."

Direct labor cost is the cost of all labor which is directly applied against the product. In certain instances this definition of direct labor costs may be questioned because of the fact that



in addition to the more usual plans of wage payment, i.e., the straight day rate and the straight piece work rate plan, many adaptations have been introduced, including wage incentives and bonus plans. Thus it becomes difficult sometimes to determine what types of incentives and bonuses are a part of direct labor costs. As a general rule it seems that all labor costs which can be measured by output and assigned directly to that specific product should be charged as direct labor costs. Where bonuses or premiums are paid annually or periodically out of earnings it is undesirable to endeavor to charge the cost of the product directly with the amount. It is also undesirable to charge it to manufacturing expense, unless it can be determined monthly or for a definite cost period. It is, therefore, proper to charge such bonuses to profit and loss. As in the case of direct material, there are instances when labor cost is charged to manufacturing expense, when in fact should be charged to direct labor costs. The reason for this is that the cost of charging these small or infrequent items against direct labor would more than offset the value of making such a charge. In other words, practical considerations sometimes must be substituted for correct accounting theory. However, a place may be made in the expense classification for such items, if desired.

**Types of Manufacturing Expense.**—All manufacturing expenses are composed of three important types:

1. Indirect materials (all materials consumed other than direct materials) (supplies)
2. Indirect labor (all labor consumed other than direct labor)
3. Indirect expenses (all expenses chargeable to manufacturing other than above)

These three groups cover all expenses borne by the manufacturing departments up to the time that the finished product is placed in the finished products storesroom, or delivered directly from the producing units to the shipping or traffic departments on the authority of the sales department.

Manufacturing expense is classified as either variable or fixed. Variable expenses are those which fluctuate from period to period, such as heat, light, supplies, and power. These fluc-

tuations, as a general rule, do not occur in direct ratio to the volume of production but in sympathy with it. Fixed expenses are those which remain more or less constant from period to period, such as rent, taxes, and insurance. In reality, these expenses do vary slightly in direct ratio to the number of days in a cost period, but for the sake of convenience most cost accountants do not recognize these small variations. It is recommended, however, that a daily or fiscal month method of apportioning be used instead of a twelve period method.

**Purpose for Classifying Manufacturing Expense.**—From the point of view of managerial control, manufacturing expenses should be classified to conform with the organizational structure of the particular concern, that is, expenses should be grouped: first, according to functional responsibility; second, according to the type of the expense incurred. Expenses grouped according to functional activity will permit management to compare operating expenses of an individual department for one cost period with similar expenses of the preceding or following periods, and also permit comparison of each item of expense from period to period. This is essential in executive control. Expenses grouped according to type enable management to hold the unit or department executive strictly accountable for each item of expense in connection with the operation of his unit or department. These departmental expenses can be compared, item by item, with the budget figures to locate variations from the standard set for any department. The essence of a classification is the method in which expenses are grouped, classified, and analyzed for each respective functional unit.

In the preceding pages of this chapter, a classification for departments was established, each department was numbered to conform with the organization plan, such as the punch press department symbolized by 1000 and the lathe department allotted the symbol 1001. It is possible to accumulate all costs of operating the punch press department under the account 1000, but later an analysis of the account would have to be made. For this reason it is necessary to establish a classification which will analyze the composition of that account.

The illustrative classification of manufacturing expense which follows makes no attempt to be complete in every respect. It is only suggestive of a method which may be applied to a manufacturing concern. Modifications will have to be made for the different types of manufacturing and thus it is designed only to illustrate principles, rather than applied practice. However, it may be pointed out that this system has been installed in a large manufacturing establishment.

This expense classification has not been designed to cover the sales and general administrative departments. Separate expense classifications will be constructed to take care of the expenses of those departments and will be illustrated in the chapters dealing with those subjects.

**Explanation of Each Account.**—There may be a variety of items charged to any one account in the classification and for this reason it is desirable to explain the account, showing the items with which it may be charged. The manufacturing expense account classification has been allotted numbers from 100 to 999, each number represents an individual account. Therefore, if the foreman of the lathe department is required to withdraw cotton waste from the stores, he makes out a requisition charging 1001-158 with the cost of that waste.

These symbols mean the lathe department and account "Operating Supplies." When the cost department makes up the manufacturing expense distribution sheet, this requisition will be recorded under department 1001 and account 158. See distribution sheets on page 112, Figure 16.

#### **Classification of Manufacturing Expense Accounts.**—

100. EXECUTIVES. Charge this account with the salaries of all factory executives and assistant executives.
101. SUPERVISION. Charge this account with the salaries and wages of all supervision, including foremen and their assistants.
102. TECHNICAL ASSISTANTS. Charge this account with the salaries and wages of all technical assistants.
103. INSPECTION. Charge this account with the cost of all inspection labor.

104. CLERKS. Charge this account with the salaries and wages of all clerical workers.
105. MESSENGERS. Charge this account with the salaries and wages of all messengers and errand boys.
106. STENOGRAPHERS AND TYPISTS. Charge this account with the salaries and wages of all stenographers and typists.
107. TIMEKEEPERS AND CHECKERS. Charge this account with the salaries and wages of all timekeepers and checkers.
108. STORESKEEPERS AND ASSISTANTS. Charge this account with the salaries and wages of all storeskeepers and assistant storeskeepers.
109. TRUCK DRIVERS AND CHAUFFEURS. Charge this account with the salaries and wages of all motor and electric truck drivers and passenger automobile chauffeurs.
110. WATCHMEN AND GATEMEN. Charge this account with the salaries and wages of all watchmen, gatemen and special detectives.
111. ELEVATOR OPERATORS. Charge this account with the wages of all elevator operators.
112. CRANE OPERATORS. Charge this account with the wages of persons operating cranes, derricks, and hoists.
113. FURNACE OPERATORS. Charge this account with the wages of persons operating and attending furnaces.
114. CUPOLA OPERATORS. Charge this account with the wages of all cupola operators and assistant operators.
115. POWER HAMMER OPERATORS. Charge this account with the wages of persons operating power driven hammers and forging machines.
116. JANITORS AND SWEEPERS. Charge this account with the wages of all janitors, cleaners, and sweepers.
117. LABORERS. Charge this account with the cost of all indirect labor which cannot be applied against any other account.
118. LOADING AND UNLOADING CARS. Charge this account with the cost of all labor involved in loading or unloading freight cars, trucks and trailers.
119. PAINTING. Charge this account with the wages of all painters, those who are engaged in maintaining buildings and equipment.

120. HANDLING SCRAP. Charge this account with the wages of all persons engaged in handling factory scrap and waste.
121. SAND BLASTING. Charge this account with the wages of all persons engaged in sand blasting.
122. OILING AND CLEANING MACHINERY. Charge this account with the cost of labor (only) of all persons cleaning and oiling machines, line shafts, counter shafts, motors, generators, pumps, conveyors, trucks, scales, elevators, cranes, hoists and all other equipment throughout the plant.
123. MACHINE SETUPS. Charge this account with the cost of labor consumed in setting up and changing dies, cutting tools, shears, reamers, grinding wheels, wire brushes, and all other equipment used on the production of parts or finished products. (The machine and part number for which a "setup" is made must be specifically shown on each time ticket bearing this classification.)
124. TRAINING EXPENSE. Charge this account with the cost of all labor spent in training and instructing new employees in the methods of production, the new employee's time, and in "breaking-in" old employees on new work or machines. (The time charged to this account must be only the excess cost of labor over and above the actual standard piece work rate, or the difference between the time of a regular operator and the new operator. Foremen must use their keenest discretion on the length of the period allowed for training.)
125. IDLE TIME—NO POWER. Charge this account with the cost of time lost of all productive workers on hourly rate or any hourly wages to be paid to piece workers who are unable to work on piece rate (the difference between cost of production on piece work and hourly wages paid) owing to the cessation of power supply, including steam, electricity or any other source of power required for production. (The cessation of power is outside the control of the department foreman.)
126. IDLE TIME—MACHINE BREAKDOWN. Charge this account with the cost of all lost time of production labor on an hourly rate, or any hourly wages, due to piece workers who are unable to work on piece rate (the difference between

the cost of production on piece work and the hourly wages paid) owing to breakdowns of either mechanical or electrical equipment. The electrical equipment includes motors, switches, starters, controllers, or distributing systems which are directly connected to the machines or equipment. The mechanical equipment includes machinery, steam, and water lines, or transmission equipment, such as shafts, belting, chains, gears, or pulleys.

127. **IDLE TIME—WAITING FOR WORK.** Charge this account with the cost of all time lost of operators or laborers, who are waiting for work. (The foreman of the respective departments will be held strictly responsible for all charges to this account.)
128. **TAKING INVENTORIES.** Charge this account with the salaries or wages of all persons engaged in taking of physical inventories within the plant.
129. **VACATION.** Charge this account with the salaries or wages of all employees who are given a vacation with pay. (This account does not include the salaries of executives, superintendents, or foremen. Authorization for payment must be obtained from the general operating superintendent.)
130. **SICKNESS.** Charge this account with the wages or salaries of all employees who are paid during illness.
131. **MILITARY SERVICE.** Charge this account with the wages or salaries of all employees who engage in military training. (Employees must obtain a certificate from the adjutant of their battalion stating that the employee attended camp. The military certificate must be presented to the paymaster and retained in the files of the company.)
132. **MAINTENANCE OF BOILERS.** Charge this account with the cost of all labor and material consumed in upkeep and repair of boilers.
133. **MAINTENANCE OF MACHINERY.** Charge this account with the cost of labor and material consumed in repairing all machinery which cannot be charged to any of the specific maintenance accounts. (All time tickets and material requisitions bearing this account number must have the machine inventory number on the face of the ticket.)
134. **MAINTENANCE OF HYDRAULIC EQUIPMENT.** Charge this account with the labor and material consumed in repairing

hydraulic pumps, hydraulic presses, hydraulic valves, and hydraulic pipe lines. (All time tickets and material requisitions bearing this account number must have the machine inventory number on the face of the ticket.)

135. MAINTENANCE OF MOTORS AND CONTROLLERS. Charge this account with the labor and material consumed in repairing all electric motors, starters, switches, and controllers. (All time tickets and material requisitions bearing this account number must have the machine inventory number on the face of the ticket.)
136. MAINTENANCE OF GENERATORS. Charge this account with the labor and material consumed in repairing or replacing all generators and rotary converters. (All time tickets and material requisitions bearing this account number must have the machine inventory number on the face of the ticket.)
137. MAINTENANCE OF LIGHTING EQUIPMENT AND ALARM SYSTEMS. Charge this account with the labor and material consumed in repairing lighting equipment, wiring, conduits, switchboards, fixtures, lamp shades, alarm systems, and call systems.
138. MAINTENANCE OF POWER LINES. Charge this account with the labor and material consumed in repairing all power transmission lines, conduits for same, and power transmission switchboards.
139. MAINTENANCE OF PIPE LINES. Charge this account with all labor and material consumed in repairing all underground and overhead pipe lines, such as sewage pipes, water pipes, oil pipes, steam pipes, and compressed air pipes.
140. MAINTENANCE OF PUMPS. Charge this account with all labor and materials consumed in repairing all horizontal, centrifugal and plunger pumps throughout the plant.
141. MAINTENANCE OF TRANSMISSION EQUIPMENT. Charge this account with the labor and material consumed in repairing all line shafts, counter shafts, pulleys, belting, chain drives, and hangers.
142. MAINTENANCE OF MATERIAL HANDLING EQUIPMENT. Charge this account with the cost of labor and materials consumed in repairing all conveyor systems, cranes, derricks, hoists, freight elevators, overhead trolley tracks,

- hand trucks, tote boxes, dolly boxes, truck platforms, and other material handling equipment.
143. **MAINTENANCE OF STORESROOM EQUIPMENT.** Charge this account with the cost of labor and materials consumed in repairing scales, bins, lockers, and all other storesroom equipment.
144. **MAINTENANCE OF DIES.** Charge this account with the labor and material consumed in repairing all power press and foot press dies. (All time tickets and material requisitions bearing this account number must have the die inventory number on the face of the ticket.)
145. **MAINTENANCE OF GAUGES.** Charge this account with the cost of labor and material consumed in repairing all standard gauges, thermometers, thermostats, stop watches, pyrometers, etc.
146. **MAINTENANCE OF TOOLS.** Charge this account with all labor and materials consumed in repairing all turning, boring, cutting, planer, milling, and shaper tools; reamers and drills (over one inch), taps (over one inch), chucking devices, and tool holders. Tools for power shears, power knives, and power saws, grinding, buffing, and polishing wheels. Threading dies and chasers.
147. **MAINTENANCE OF FOUNDRY EQUIPMENT.** Charge this account with the cost of all material and labor consumed in repairing and maintaining all foundry equipment.
148. **MAINTENANCE OF FURNACES.** Charge this account with the cost of all labor and material consumed in repairing, relining, or rebricking all furnaces.
149. **MAINTENANCE OF CUPOLAS.** Charge this account with the cost of all material and labor consumed in repairing all cupolas.
150. **CORE MAKING EQUIPMENT.** Charge this account with the cost of all material and labor consumed in repairing and maintaining all core making equipment.
151. **MAINTENANCE OF TRUCKS.** Charge this account with the cost of all labor and material consumed in repairing all motor trucks, and industrial trucks.



152. MAINTENANCE OF TRACKS. Charge this account with the cost of labor and material consumed in repairing narrow and broad gauge tracks other than overhead trolley tracks.
153. MAINTENANCE OF OFFICE EQUIPMENT. Charge this account with all labor and material consumed in repairing all office equipment, such as desks, chairs, racks, tables, filing cabinets, drawing boards, adding machines, calculating machines, typewriters, ediphones, and other office equipment. (All time tickets and material requisitions bearing this account number must have the equipment inventory number on the face of the ticket.)
154. MAINTENANCE OF EQUIPMENT (BUILDINGS). Charge this account with all labor and material consumed in repairs to building equipment. This will include all building equipment which is not a permanent part of the building, such as sprinkler systems, wash-stands, faucets, sewage pipes (inside the building), drinking water fountains, ventilators, blowers, fans, heaters, radiators, fittings, and fixtures.
155. MAINTENANCE OF BUILDINGS. Charge this account with the cost of labor and material consumed in repairing, painting, or renovating buildings. (All time tickets and material requisitions bearing this account number must have the building inventory number on the face of the ticket.)
156. MAINTENANCE OF ROADS, GROUNDS, AND DRIVEWAYS. Charge this account with all labor and material consumed in repairing roads, grounds, driveways, sidewalks, and fences.
157. PERISHABLE TOOLS. Charge this account with the cost of all perishable tools, such as:

Anvil Tools  
Arbors  
Auger Bits  
Awls  
Axes  
Bars, Boring  
Bars, Broaching  
Bars, Claw and Crow  
Bellows, Hand  
Bit Braces  
Bits  
Blacksmith Hand Tools

Blades for Hack-Saws  
Boxes, Miter  
Breast Drills  
Broaching Cutters  
Calipers  
Center Punchers  
Chasers, Thread  
Chisels  
Chucks, Drill  
Clamps  
Counterboring Tools  
Counter-Sinkers

Crowbars	Milling Tools
Cutters, Boring, Counterboring, and Facing	Nail Pullers
Cutters, Broaching	Nippers
Cutters, Glass	Paint
Cutters, Inserted Reamer	Picks
Cutters, Inserted Tooth-Saw	Pinch Bars
Cutters, Milling	Pinchers
Cutting Tools	Pitchforks
Diamonds, Black and Bortz	Planer Tools
Dies, Small Threading	Planes
Dogs for Chucking	Pliers
Dogs, Lathe	Plumb Bobs
Dolly Boxes	Plumbers' Tools
Dressers for Grinding Wheels	Polishing Wheels
Drifts, Drill	Pots, Soldering
Drifts, Hand	Protectors
Drill Chucks	Punches, Center
Drills, Twist (up to one inch)	Rakes
Drivers, Screw	Rammers
Emery Wheels	Reamers
Expanders	Riddle, Sand
Facing Tools	Rods, Skimming
File Brushes and Handles	Rulers
Files	Sand Wheels
Flatters	Saw Blades
Forks, Coke, Scrap, and Pitch	Screw Drivers
Frames, Hack-Saw	Shaper Tools
Gate Knife (Moulders)	Shear Blades
Glass Cutters	Shears or Scissors, Hand
Grindstones	Shovels
Grooves	Sieves
Hack-Saw, Hand	Skimming Rods
Hammers, Hand	Slatter Tools
Handles, File, Hammer	Sledges
Hatchets	Slings, Chain and Rope
Hoes	Sockets, Drill
Hooks, Chain, Hand, Core	Soldering Irons
Irons, Soldering	Steel Squares
Knives	Steel Stamps
Ladles	Stones, Oil and Water
Lathe Tools	Tapes, Measuring
Levels, Spirit	Taps (up to one inch)
Mallets	Thermometers
Mandrels	Threading Dies
	Tongs

Tool Holders	Trowels
Tools, Boring, Countering, Facing, Countersinking, Milling, Broaching, Lathe, Planer, Shaper, Slotter, Moulders' and Core-Makers' Wheel Dressing and Woodworking	Tweezers Welding Tips Wheel Dressing Tools Wire Brushes Wrenches

158. OPERATING SUPPLIES. Charge this account with the cost of all miscellaneous supplies such as:

Acid	Cloths, Dust and Wiping
Acid Crocks	Coal (Miscellaneous use)
Alcohol	Coal Oil
Ammonia	Coke (Miscellaneous use)
Anchors	Compounds, Boiler, Cleaning
Barrels	Cord
Baskets	Crayons
Beeswax	Crocks, Acid
Belt, Cement	Crucibles
Bells, Electric	Cups, Tin
Belt Dressing	Cuspidors
Belt Fasteners	Dippers
Belt Laces	Disinfectants
Benzine	Drip Pans
Boards, Bulletin	Dusters, Dust Brushes
Bone, Case Hardening	Dust Pans
Borax	Faucets
Bottles	Fire Clay
Brooms	Flour
Brushes, Bench	Flux for Welders
Brushes, Scrub and Dust	Garbage Cans
Brushes, Sweeping	Garden Hose
Buckets	Gasoline (Miscellaneous use only)
Candles	Glass
Cans, Garbage, Oil, and Scrap	Gloves, Leather and Rubber
Carborundum, Dust	Glue
Case Hardening Compounds	Glue Pots
Cement, Belt, Rubber, and Building	Goggles
Chalk	Helmets
Charcoal	Hose, Air and Water
Chloride of Lime	Ice
Clay, Fire	Janitor's Supplies
Clogs, Wooden	Kerosene (Miscellaneous use only)
Cloth, Emery	

Laces, Belt	Resin
Ladders	Rope, Hemp
Lanterns	Rosin
Lavatory Supplies	Salt
Lead, White and Red (Miscellaneous use only)	Sandpaper
Limestone	Shellac
Linseed Oil (Miscellaneous use only)	Smooth-on-Cement
Lye	Soapstone
Marking Pots	Soda Ash
Matches	Solder
Metal Polish	Soldering Paste
Mops	Sponges
Muslin	Stencils
Nails	Tacks
Pails	Tags
Paper, Sand and Emery	Tallow
Paper, Toilet	Tape, Friction
Paraffin	Tin Cups
Paste	Toilet Paper
Paste, Soldering	Towels
Plumbago	Turpentine (Miscellaneous use only)
Pots, Soldering	Twine
Putty	Washers
Rags	Waste, Cotton
	Whiskbrooms

159. LUBRICANTS AND CUTTING OILS. Charge this account with all lubricating oils, lubricating greases, cutting oils, and cutting compounds.

160. OFFICE SUPPLIES. Charge this account with office supplies such as:

Binders	Ink
Blank Books	Ink Pads
Blank Cards	Ink Stands
Blank Pads	Mucilage
Blotters	Oil Paper
Blueprint Paper	Paper, Blank
Carbon Paper	Paper Boxes
Clips	Paper Cutters
Copy Books	Paper Fasteners
Erasers	Paper Weights
Eyelets	Paste
Filing Boxes	Pencils
Indexes	Penholders

Pen Racks	Sponge Cups and Sponges
Pens	Stamps, Impression
Rubber Bands	Staples
Rubber Stamps	Tablets
Rulers	Tape, Mending
Sealing Wax	Tissue Paper
Seals	Typewriter Ribbons

161. PRINTING AND STATIONERY. Charge this account with cost of all stationery printed or purchased.
162. POSTAGE. Charge this account with the cost of all postage consumed in the course of operating the business.
163. TELEPHONE AND CABLE. Charge this account with the cost of all telephone, telegraph, and cable service, and the cost of switchboard operation.
164. ELECTRICITY. Charge this account with all electric current consumed.
165. STEAM. Charge this account with all steam consumed.
166. WATER. Charge this account with all water consumed.
167. FUEL. Charge this account with the cost of all coal, fuel oil, gas, or other fuel.
168. DISCREPANCIES. Charge this account with the amount of the discrepancy between the book figures and actual physical count of raw materials, work in process, and finished product.
169. EXPERIMENTAL EXPENSES. Charge this account with all labor and material consumed in experimental processes or experimental product development.
170. DEMURRAGE. Charge this account with the cost of all demurrage on freight cars, boats, barges, etc.
171. TRAVELING EXPENSES. Charge this account with the amount of traveling expenses incurred by any employee of the factory authorized to travel on company business.
172. MEDICAL SERVICE. Charge this account with the service of all persons connected with the first-aid hospital, and all medical or surgical supplies consumed therein.
173. SAFETY AND SANITATION. Charge this account with all expenses incurred in connection with accident prevention, safety, sanitation, educational work, campaigns for re-

duction of accidents and reducing sickness and absence due to illness.

174. FIRE PROTECTION. Charge this account with the salaries and wages of fire chief and assistants, along with the cost of maintaining all fire equipment, including renewal of chemicals in the chemical fire extinguishers.
175. FREIGHT, EXPRESS, AND CARTAGE. Charge this account with the cost of all freight, express, and cartage which is not charged directly to the cost of raw materials, shop orders, equipment orders, or rejected material returned to vendors on which the company must assume the cost of return.
176. SPOILED WORK. Charge this account with the cost of all labor and materials expended on products which have been spoiled in the manufacturing processes. (Foremen will be held directly responsible for all charges to this account.)
177. SOCIAL SECURITY. Charge this account with the amount of the payroll tax required under the Social Security Law.
178. UNEMPLOYMENT INSURANCE. Charge this account with the amount of the payroll tax required under the State Unemployment Insurance Law.

#### FIXED CHARGES

200. RENT. Charge this account with all payments of rent for buildings, land, and storage space.
201. TAXES. Charge this account with all municipal and state taxes on land, building and equipment. (This does not include federal or state income tax.)
202. INSURANCE. Charge this account with all fire insurance and employers' liability insurance premiums.
203. DEPRECIATION OF EQUIPMENT. Charge this account with the estimated depreciation of all equipment and machinery.
204. DEPRECIATION OF BUILDING. Charge this account with the estimated depreciation of all buildings.

**Uses of Manufacturing Expense Classification.**—Each individual authorized to make out labor time tickets or material requisitions is provided with a copy of this account classification and explanation, and also, a numerical list of factory departments.

Thus it becomes easy to show on the time ticket, or material requisition, the department and account to be charged with each item of expense. Furthermore, the cost division is enabled, through this plan, to collect and assemble all expenses incurred according to class and by department. All items of expense labor are accumulated, by class, on the payroll summary and distributed monthly on the manufacturing expense distribution sheet to the individual departments by account numbers. The cost of all materials charged to manufacturing expense are accumulated, by class, on the material distribution sheet and at the end of the month, or cost period, are distributed on the manufacturing expense distribution sheet to the individual departments by account numbers. Other items of manufacturing expenses are obtained from the purchase analysis (voucher register) and redistributed on the manufacturing expense distribution.

This provides for the complete distribution of all manufacturing expenses. (See Figure 16.) Thus management is able to see at a glance the total amount of expense incurred by each department and the classes of expense which comprise that particular total. By comparing these actual figures with the budgeted or standard figures the executive obtains quick and accurate information as to variations between planned and actual expenditures for each item of expense and for each department concerned.

When a substantial variation between budgeted or standard and actual expenses occurs, management is at once informed of the fact and may then proceed with a detailed examination of the specific account in question, or of all the accounts in a given department, in order to determine the specific causes for variations.

**Classification of Orders.**—For the sake of accuracy and identification, it is desirable to number all sales orders by using the symbols S37-1, S37-2, and so on numerically, until the end of the particular fiscal year. These symbols represent a sales order issued in 1937; thus S38-1 means that this is the first sales order issued in 1938. This particular classification permits ready reference to any sales order and there is little possi-





bility of error in determining when and to whom the sale was made. Jobbing orders, shop orders and production orders may be handled in a similar manner by prefixing the symbols Jo37-1, Sho37-, and Po37-, to the actual order number, starting at number one the following year. The establishment of such a system of classification will avoid the use of large numbers and of one series of numbers running into another. For instance, if the numbers allotted to jobbing orders are from 30,000 to 49,999, and those allotted to production orders are 50,000 to 100,000, eventually the numbers will be duplicated and cause trouble.

**Classification of Equipment.**—Machines should be classified according to type and nature of work performed, and a capital, alphabetical letter assigned to represent each class of machine, as follows:

- A Automatic Screw Machines
- B Buffers and Polishers
- C Gear Cutting Machines
- D Drill Presses
- E Punch Presses
- F Shearing Machines
- G Grinding Machines
- H Tapping Machines
- K Planers
- L Lathes
- M Milling Machines

Each class of machine is numbered consecutively so that if there are four buffing machines in the polishing department, they should be numbered as follows: B-1-1007, B-2-1007, B-3-1007 and B-4-1007; the letter designates the type of the machine, the first numeral its number and following group the department where the machine is located. An equipment ledger card (see page 145) should be set up and maintained for each individual piece of equipment as required by the Federal Treasury Decision 4422. This ledger card should bear the same number as the machine, B-1-1007, and ledger

cards should be filed by departments so that it will be an easy matter to check the physical machines with the card record and obtain an accurate record of the equipment investment in each department.

It is also desirable to use this method of equipment accounting for the purpose of determining the necessary depreciation which should be charged to the particular department.

The cost accountant is responsible for keeping the equipment ledger. It is his duty to issue all equipment numbers when new machines are purchased for the plant. Where a machine is moved from one department to another, a new number should be issued. For instance, lathe number L-10-1001 is moved to the maintenance department where there is already one lathe, L-1-1101; then the transferred lathe should be numbered L-2-1101 and the record changed accordingly. Also it is essential that the respective machine numbers be placed on plates, either of brass or aluminum, and riveted, or welded, to each machine.

**Tool Classification.**—The purposes for classifying tools may be stated as follows: (1) immediate identifications; (2) ease of storing and issuing; (3) ease of keeping records; (4) ease of determining tool use.

Regardless of the nature of the tool, it should be classified according to the specific purpose for which it is used and each class of tool must bear a mnemonic symbol which identifies it from all other tools. Where capital letters are utilized for machine classification, small letters should be used for tool identification.

- a — Abrading tools; dressing, filing, girding, knurling, sharpening, and scraping
- b — Blanking tools; dies, punches, shearing blades
- c — Cutting tools; milling cutters, gear cutters, slotting saws
- d — Drilling tools; boring tools, drills, reamers, tapping tools
- f — Forming tools; tools for forming parts
- h — Holding tools; blocks, clamps, dogs, arbors, tool holders
- m — Measuring tools; calipers, gauges, levels, scales

Again it may be said, this classification may be expanded indefinitely to cover all classes of tooling; for instance Ld represents a lathe boring tool, Dd represents a drill, Ddt represents a twist drill and Ddtt might represent a taper-shank twist drill. The tool classification symbol should be stamped or etched permanently on each tool so that it cannot be removed without destroying the tool.

**Classification of Drawings, Parts and Products.**—Drawings should be classified according to type of product. All manufactured parts should be numbered in agreement with the drawing, but castings should bear the pattern number. All finished assembled products should bear a serial number made up of symbols indicating the date of manufacture, the batch or production order number and the number of the product itself; for instance, serial A37105 means that the product was manufactured in January, 1937 (A symbolizes January, B, February, C, March, etc.) and was the hundred and fifth assembled.

The serial number of a sold product should be placed on the sales order and that serial number recorded in a ledger showing by whom purchased, address of purchaser, date of shipment, sales order number, number of times it was serviced or returned to the plant for repairs, and ultimate disposition. A record of this nature is invaluable to management as it identifies the product, may permit the determination of its life, may permit comparison of operating efficiencies of identical products under various conditions, may permit the compilation of valuable statistical information regarding the life of products for advertising and other purposes, and provides innumerable other data which are indispensable to a wide-awake management.

## CHAPTER 7

### DIFFUSION OF EXPENSE

**Manufacturing Expense Defined.**—Manufacturing expense is all expenditures incurred in the manufacture of the product other than the cost of direct materials and direct labor. Manufacturing expense, erroneously called burden, is probably the most difficult part of cost to determine and to distribute correctly. The science of cost accounting has not yet developed the one correct method for diffusing the cost of all items of manufacturing expense to the cost of the product so that it will be equitable from the standpoint of accurate cost. The term overhead expense is often loosely used to mean manufacturing expense whereas in reality it includes manufacturing, sales, and general administrative expenses.

**Expense Diffusion Defined.**—Diffusion of expense means to apply the expenses involved in producing a commodity to the prime cost of that commodity in the same ratio as the value of those auxiliary services aided in producing the commodity. Diffusion of manufacturing expense is the most intricate and complex phase of cost accounting. The classification of manufacturing expense accounts furnishes a direct allocating medium for a great number of items of expense to the operating and service departments; but other items must be distributed on some more equitable bases.

**Theory of Diffusion.**—The theory underlying the diffusion of manufacturing expense against the cost of a product, is based on the premise that the product, as it passes through the various phases of production, requires certain auxiliary services for its completion other than productive operations and that its cost increases in direct proportion to the amount of these auxiliary services. For example, such expense items

as power, machine maintenance, material handling, and inspection, constitute special services to productive operations and, consequently form an integral part of the cost of the manufactured product. Based on this theory, management has divided the physical factory into organization units known as departments and cost centers, so that the cost of these auxiliary services may be applied in some equitable manner to the operating organization unit and thence to the cost of those products which pass through that unit in the course of production. The very nature of manufacturing expense shows that it applies to all commodities or production and that it is impossible to calculate the absolute cost of these services for each unit of product. Therefore, methods must be devised for determining costs which are reliable for all practical purposes and simple to calculate.

**Process of Diffusion.**—Many manufacturing concerns produce a great variety of commodities which, in the course of manufacture, require different lengths and different auxiliary services in their process of completion. From this situation arises many complicated problems in cost accounting relative to the determination of the expense cost of the various units of product. This is impossible to ascertain without procuring first the cost of operating each department or cost center. This may be accomplished partly through the manufacturing expense classification and partly through desirable methods of diffusion.

All factory expenses are incurred for the benefit of manufacturing operations and each organization unit should bear its proportionate share of these expenses.

All general factory expenses should be diffused first over the operating and service units and in this manner each of the units receives its proportionate share of these costs. The cost of operating these service units should then be diffused over the operating units in the same relationship as the auxiliary services rendered to the particular operating unit. Thus a reliable cost of each operating unit can be determined for all purposes and as the product passes through each of the respective operating units, an expense cost can be applied to the cost of that specific product. Furthermore, a definite expense rate can be calculated

for each of the various operating units for the purpose of applying expense to the work in process, estimating costs of products, and compiling certain phases of standard costs.

Management should be careful to limit, as far as possible, the distribution and redistribution of certain items of expense to service units and the reapplication of these expenses to the operating and service units. The same policy should be established for the diffusion of reciprocal items of expense, such as lighting costs, or power costs, which may be applied on the basis of consumption to the service and operating units. Before the cost of power can be obtained, the consumption of light and power in the power department itself must be determined.

**Bases of Diffusion.**—The use of various factors for diffusing manufacturing expense is based on the theory that the particular factor has a direct relationship to the expenses involved. The use of the time factor, for instance, assumes that certain expenses are incurred in direct proportion to the passage of time, such as depreciation and rent. The following bases are suggested for diffusing various items of expense, and with careful analysis, it is possible to develop a much more inclusive group of bases.

**Bases for Diffusing Expenses.—**

1. **BY DIRECT ASSIGNMENT.** A great number of the various types of expenses may be charged direct to an organization unit (department or division) such as: material and supplies consumed by the unit; indirect labor of the unit; power, light, water, gas, insurance, heating.

2. **DIRECT LABOR HOURS.** Various expenses may be distributed on the basis of the number of direct labor hours consumed in production in the specific department. This method assumes a direct relationship between productive hours consumed and expenses incurred.

3. **DIRECT LABOR COST.** Expenses may be distributed on the basis of the direct labor cost which assumes a direct relationship between the cost of productive labor and the cost of the various items of expense.

4. **MATERIALS COST.** Many large industrial concerns are distributing certain items of expense on the bases of material costs, which assumes a direct relationship between the cost of the material and the cost of these expense items.

The cost of operating the purchasing department, receiving department, and stores department, is charged to the cost of the incoming materials on the basis of the value of the materials.

An absorption rate per material cost dollar is established and the materials cost is increased by this amount. Other expenses, like material handling expense, may also be distributed on this basis but it is undesirable to do so as there is little or no relationship between the costs of material and the costs of handling the material. The cost of insurance of materials in a department, or division, can be distributed on the basis of cost of materials.

5. **AREA OCCUPIED BY AN ORGANIZATION UNIT.** There is a direct relationship between the area of a department, or division, and certain types of service expenses, so that this is a desirable basis, in some cases, such as: janitor service, lighting, rent, taxes, insurance, elevator service, handling materials, watchmen's service.

6. **CUBIC SPACE OCCUPIED BY AN ORGANIZATION UNIT.** A direct relationship does exist between cubic content and certain items of expense, such as, heating, air conditioning, dust collection, painting, cleaning, maintenance.

7. **NUMBER OF PROCESSES AND/OR OPERATIONS PERFORMED IN AN ORGANIZATION UNIT.** This basis assumes a relationship between the number of operations performed and certain items of expense, such as the expenses incurred in operating the production control department.

8. **HORSEPOWER HOURS OF ENERGY.** This factor is used to distribute power consumed by an organization unit.

9. **WATT OR CANDLEPOWER HOURS.** These factors are utilized for distributing light consumed by the department or division.

10. **METER READINGS.** This is the most desirable method for distributing expenses and provides for measuring by meter, water, electricity, steam, gas, and time elapsed. The engineering department should be required to furnish separate meter readings, where possible, of all measurable expenses.

11. **NUMBER OF EMPLOYEES IN AN ORGANIZATION UNIT.** There is a definite relationship between the number of employees in a department, or division, and certain items of expenses, such as, employment service, timekeeping expense, payroll division expense, recreation facilities, medical service, employee education expense, general factory supervision, safety service, employee welfare service, sanitation and cafeteria service.

12. **AMOUNT OF PAYROLL FOR AN ORGANIZATION UNIT.** A definite relationship exists between the amount of money earned by an employee and certain items of expense, such as, federal and state old age pension tax, group insurance, liability insurance.

13. **COST OR VALUE OF ASSETS.** A very definite relationship exists between the cost, or value, of assets in the various departments, or divisions, and certain items of expense, such as, depreciation, taxes and fire insurance.

14. **NUMBER OF MACHINES AND PIECES OF EQUIPMENT IN AN ORGANIZATION UNIT.** There is a direct relationship between the amount of equipment and certain maintenance expenses, such as, cleaning, oiling, and inspection of machinery.

15. **WEIGHT AND/OR CUBIC CONTENT OF MATERIALS.** These factors are utilized in many cases to distribute the cost of material handling and storage expenses.

16. **EQUAL SHARE ALLOTMENTS.** Certain items of expense may be divided equally among the various departments, such as the salary of the general supervisor, on the theory that regardless of the number of employees in a department, each activity requires the same amount of supervision.

17. **RELATIVE IMPORTANCE OF PRODUCTIVE ORGANIZATION UNITS.** This basis assumes that each department has a relative



value in the system of production and that certain items of expense should be consumed on that ratio, such as, research expenses and experimental expenses (except where these expenses are incurred for a specific department or other organization unit).

**Allocation to Product.**—The monthly distribution of departmental expenses on the basis of the expense classification is sufficient data for charging expenses to the cost of the product, where a system of process costs is in use; but where it is desired to determine the cost of individual jobs or lots, a suitable rate of expense absorption must be determined for each of the operating departments. The plan generally in use is the direct labor hour method, which assumes that expenses are directly proportional to the number of productive hours of work. At the end of the month the total expenses of each department are added and a ratio of the productive hours of each department to the total expense incurred in that department is determined:

$$\frac{\text{Total expense}}{\text{Total productive hours}} = \text{Rate of expense}$$

This rate of expense absorption is applied to the direct labor hours of the job. For example, the total productive labor hours of the lathe department is 4000 and the total manufacturing expense of that department for a month amounts to \$8,400; then the rate required to absorb that expense is \$2.10 per productive hour. If the specific job requires ten hours of lathe work, then the expense applied to the job will amount to \$21.00.

**Normal Production and Manufacturing Expense.**—In principle, it is not always desirable to absorb all manufacturing expense of a cost period in the cost of the product manufactured during that period without first taking into consideration the expected degree of activity and the volume of production for the fiscal period. In periods of low productivity, unit costs will be ridiculously high and of little practical use, while in periods of high productivity, unit costs will be low and profits will be high. For this reason it is desirable to consider the

possible effects of variations in productive capacity upon the rate of expense absorption in order to establish a rate which will absorb the total manufacturing expense for the normal fiscal period. In calculating the rates for diffusing manufacturing expense, management should determine, through an analytical study, two important factors: 1. The normal<sup>1</sup> manufacturing expense for each organization unit; 2. The normal productive capacity of each of these organization units in terms of direct labor hours, machine hours of operation, volume of production or total man hours, according to the bases used for diffusion of expense. The normal rate of diffusion should be based on these factors and all unabsorbed expense should be charged to a special account and later cleared into profit and loss. In many instances it is important to use these normal rates because a vast majority of manufacturers set their selling prices many months in advance of the actual production and cost periods. In some cases manufacturing expense is more or less constant throughout the year, but there may be seasonal variations which affect production, and if the normal rate is set correctly, in all probability the total manufacturing expense will be absorbed during the fiscal year. It is highly important that the total yearly manufacturing expense be absorbed in the costs of the products for that particular year.

The importance of using a normal rate for diffusing manufacturing expense may be illustrated by the following figures, showing a constant amount of manufacturing expense with a varying production for the Christmas season.

	Manufacturing Expense	Volume of Production	Actual Expense on Product	Normal Expense
July .....	\$10,000	5,000	\$2.00	\$1.00
August .....	10,000	7,500	1.33	1.00
September .....	10,000	10,000	1.00	1.00
October .....	10,000	15,000	.67	1.00
November .....	10,000	15,000	.67	1.00
December .....	10,000	7,500	1.33	1.00
Total .....	\$60,000	60,000		\$1.00

<sup>1</sup> Managerial Concept of Normal: The volume of productive activity taken in a series of operating periods in which productivity has varied due to the action of observed economic laws and managerial policies.

**Factors Affecting Manufacturing Expense.**—Management should be cognizant of the fact that many factors affect manufacturing expense and a change in managerial policy, or unforeseen conditions, may have a vital effect upon the operating expenses of the plant. The important factors may be enumerated as follows:

1. **CLIMATIC CONDITIONS.** Cold, long winters may mean additional fuel for heating and additional light is required on dark days. During hot periods, air conditioning units may be necessary.

2. **FACTORY CONDITIONS.** (a) Poor working conditions in the plant may lead to high labor turnover; (b) poor buildings, machines, and equipment will result in high maintenance costs; (c) poor lighting means defective workmanship; (d) poor supervision may result in high costs of operations.

3. **WAGES.** (a) The morale, loyalty, and productivity of the workers are affected by wages received; (b) straight hourly wages for workers decrease clerical and accounting costs; (c) the application of the piece rate system increases productivity; (d) complicated wage incentives and bonus systems increase clerical, inspection, and other costs, which may be offset by increased production.

4. **VOLUME OF PRODUCTION.** Management should determine the economical size of the lot, or batch, for each product. Long, steady runs of production generally mean a low cost, while short runs, or individual jobs, mean high cost. The economies resulting from long runs are: (a) machine setup is less frequent, and its costs are distributed over a large volume, which means lower cost per unit of product; (b) material handling expense is spread over a large volume of production, thus decreasing the cost per unit; (c) supervision, inspection, and other service labor costs are reduced per unit by reason of quantity; (d) spoiled work is reduced by reason of the operator becoming a specialist on his job.

5. **NUMBER OF PIECES IN PRODUCT.** (a) The product which consists of a large number of individual pieces may require many patterns, cores, templates, dies, jigs, fixtures and

other tooling, which will result in increased maintenance costs; (b) engineering facilities, drawings, blue prints, and inspection activities, result in high operating costs; (c) assembly costs are increased; (d) handling, storage and clerical recording costs will be high.

6. **PRODUCT OPERATION AND PROCESS.** The greater the number of operations and processes required on parts or products, the greater the amount of service expense necessary to complete the product.

7. **NATURE OF PRODUCT.** The character of the work performed and the nature of the product will have a decided bearing on the cost of auxiliary services required. For instance, a factory producing precision instruments will probably require more auxiliary services than the plant manufacturing mechanical toys.

There are many other factors which might be listed, but it is not intended to make a complete list but merely to illustrate the type of factors which management must study carefully before making decisions in respect to manufacturing expense and its diffusion.

**Importance of Selecting a Sound Method.**—From the general accounting records the total cost of manufacturing expense may be obtained. The expense distribution sheet will give also specific information regarding items of expense and the departments consuming that expense, but the difficulty of finding a suitable basis for diffusing expense is the problem which management must solve. Large scale operations, keen competition, variety of products, impersonal management, and many other reasons, make it necessary for management to obtain accurate costs of manufacturing its products and the costs of operating its individual organization units. The method used for diffusing expense must provide an equitable basis for the distribution of expenses in order that the expenditures charged against the cost of the product in any given department will reflect the true departmental cost of that product.

It is a well-known fact that in a competitive industry one method of diffusing expense will result in an apparent profit,

while the use of another method will show an apparent loss. The method used by some cost accountants is often arbitrary and in many cases fails to produce an accurate cost of manufacturing the product. The accurate diffusion of manufacturing expense, therefore, depends, primarily, on choosing correct bases of measurement and distribution. A simple illustration may be cited to explain the possibility of error in selecting a method. The total number of workers in the punch press department may be similar to the number of workers in the automatic screw department, but the productive labor costs of the former may be twice as great as that in the automatic screw department. If the direct labor cost method is used for distributing service expenses in each of these departments, it is obvious that the cost of production, in one or the other, will be incorrect. It is, therefore, management's responsibility to determine the methods of expense diffusion.

**Methods of Diffusing Manufacturing Expense.**—Many plans for diffusion have been suggested by various authorities, all of which possess merit, but some apply only to specific types of industry while others are more general in scope and, according to their sponsors, may be used in any type of business. A careful analysis of the various methods will reveal the fact that about four of the plans are fundamental and others are variations of these. Again, it is pointed out that management must use care and discretion in selecting the method of diffusion to be adopted because the conditions in one department may be entirely different from those in another department, and in all probability two or more methods should be utilized.

**Direct Material Cost Method.**—This plan assumes the existence of a relationship between the amount of direct material, expressed in dollars, consumed in the manufacture of a product, and the expenditures for services required in connection with its manufacture. There are a great many instances in which it would be difficult to relate the cost of the direct materials to the indirect expenses incurred in their fabrication. For example, in a foundry the cost of the gray iron would not be in any direct proportion to the indirect expenditures

made in turning out the castings. At the same time, practically the same amount of expense is involved in casting bronze which is a more expensive metal than gray iron. In cases where a uniform type of material is used and a uniform type of product is turned out, and manufacturing expenses do not fluctuate, and the rate of diffusion applied may be checked, the direct cost method may give satisfactory results. However, such a condition as this seldom exists in reality, and the use of this method is therefore likely to bring about irregularities in costs. Thus, if an exceptionally high-priced raw material is used it must absorb a certain amount of manufacturing expense which does not exist. Likewise, if a very low-priced material is used, the amount of manufacturing expense loaded on the material cost may be less than it should be. In either case no relationship exists between the cost of material and the amount of manufacturing expense loaded on the material cost.

It could happen in two such cases as are illustrated above, that a similar variation each way would result in no over- or underabsorption of expense. That is, the excess amount of expense loaded on the cost of the high-priced materials might be sufficient to offset the small amount loaded on the cost of the low-priced materials. The results would be an average cost of the product. Granted that this plan might lead to an average cost, it would be unsatisfactory. Costs are much too important to management to accept such uncertain bases for securing them. The cases illustrated show the uncertainty of this method in securing accurate costs. It may, therefore, be regarded as impractical in most cases with the exception of its utilization for absorbing such items as materials receiving, handling, and storing expenses. The direct material cost method has to recommend it the fact that it is simple to operate, requires little effort in calculation, and is quick and convenient.

$$\frac{\text{Total Manufacturing Expense}}{\text{Total Material Cost}} = \text{Rate per Dollar of Material}$$

**Direct Labor Cost Method.**—One of the oldest and perhaps the simplest plan of diffusing manufacturing expense is the direct labor method. This plan assumes that there is a direct

relationship between the amount of wages paid to direct labor and the indirect expenditures incurred in manufacturing. Where a plant is producing a single product, the earnings of direct labor are uniform and the machines used are alike; the relationship between the cost of direct labor and manufacturing expense may be determined with a fair degree of accuracy. Where two or more products are being manufactured this method may be satisfactory also, provided the same conditions exist. If there is a wide variation in the earnings of direct labor, the direct labor cost method is likely to result in distorted costs. This must be the case, inasmuch as the amount of manufacturing expense distributed against a given product is in proportion to the wages of direct labor expended in producing that product.

$$\frac{\text{Total Departmental Expense}}{\text{Total Departmental Direct Labor Cost}} = \frac{\text{Departmental}}{\text{Rate per Direct Labor Dollar}}$$

#### **Advantages and Disadvantages of Direct Labor Plan.—**

The simplicity of this plan and the ease with which the rate may be calculated and the expenses distributed over the product manufactured, are perhaps the outstanding advantages of this plan. The main disadvantage of the plan is that the amount of expenses applied against production is affected by the rates of wages paid to direct labor. For example, length of service is a factor in setting pay rates; thus, an old employee would likely receive higher pay than a recent employee for producing the same volume of product. Therefore, the amount of manufacturing expense applied against each man's output will be different, while as a matter of fact, it should be the same. Perhaps the reason for the direct labor cost method being the most generally used method is the fact that this plan is inexpensive to operate and, although not giving accurate results, is satisfactory to a management which does not fully realize the advantage of more accurate costs.

**Direct Labor Hour Method.**—This plan contemplates the use of time rather than the cost of labor or materials as the basis for diffusing manufacturing expenses. The argument in

favor of this method is predicated upon the assumption that manufacturing expenses are incurred in relation to time rather than to the cost of labor. Illustrations are given to support the argument as follows: Depreciation expense is incurred in relation to the passage of time when the machinery is in use or, for that matter, when idle. Likewise, it is argued that both power and rent expenses are incurred in direct relation to time. It is further stated that these three elements comprise a large part of manufacturing expense and that the use of time as a basis for the distribution of the other elements of manufacturing expense, while perhaps not incurred in direct relation to the passage of time, is not inequitable.

Opposition to the use of the direct labor hour plan is found in some quarters. The basis for the opposition is that the elements of manufacturing expense which are incurred in relation to the passage of time are not the major elements of manufacturing expense, and that such elements as maintenance, indirect labor and materials, supervision, engineering, production control, etc., are greater in total than those elements directly related to time, and that through the use of this method, inaccurate distribution is made and costs are distorted. This opposing school further contends that in a plant where part of the work is performed by hand labor and part is performed by machine, the product turned out by hand labor will receive a larger proportionate share of manufacturing expense than will the product of the machine work. It is maintained that the product made by machine should receive the larger share of manufacturing expense inasmuch as power, depreciation of machinery, and other forms of manufacturing expense are consumed in larger amounts in machine operations. This argument appears sound since but little machinery is used where hand methods are employed. It is further argued that this plan may be incorrect because the machine element is not given sufficient consideration.

**Computing the Direct Labor Hour Rate.**—To find the amount of manufacturing expense to be applied against the product in a given department, take the total direct labor hours for that department and divide the total into the total manufac-



turing expense for that department. This gives the departmental rate for applying manufacturing expense against the product. The total units of product of the department divided into the total number of direct labor hours consumed in its manufacture will give the direct labor hours expended per unit of product. Then, if the direct labor hours expended per unit of product be multiplied by the departmental rate, the result will be the total amount of manufacturing expense consumed per unit of product. A direct labor hour rate should not be calculated for the plant as a whole. The main reason for this is that products seldom pass through all departments of the factory, and therefore a constant for the plant as a whole would be of little value for accurate cost finding purposes. If a single plant rate was calculated, it would equalize the rate of applying manufacturing expense without regard to the real rate of consumption for a given department. Suppose, for example, that the parts produced in a department having a high rate not only form part of the assembled product but are also sold as independent parts. It will be readily seen that the selling price of these parts will be altogether too low due to the application of an average absorption rate.

$$\frac{\text{Total Departmental Expense}}{\text{Number of Productive Hours}} = \frac{\text{Departmental Rate per Productive Hour of Operation}}$$

The records required in the direct labor hour method are more numerous than those required in the direct labor or direct material cost methods.

**Additional Records Required.**—In addition to the records needed and maintained for cost and payroll or other purposes, the two following records must also be kept. (1) The number of direct labor hours spent on each job in each department; (2) The total number of direct labor hours of each department. Keeping these additional records may cause an increase in the cost of clerical work. The increased cost of operating the direct labor hour method should, as a rule, be no bar to its use, provided the cost data is accurate and dependable.

In factories where the work is performed largely by hand methods, the direct labor hour is regarded as an efficient method

for distributing manufacturing expense. However, in factories where the majority of the work is performed by machines, it seems desirable to consider the question of establishing a method which will give more weight to the activity of the machine, which, after all, is the apparent basis for the amount of manufacturing services rendered.

**Machine Hour Rate Method.**—This method employs time as the basis for the distribution of manufacturing expenses against the product, but in a different manner from the direct labor hour plan. The machine rate method assumes that most of the manufacturing expenses are incurred more or less in proportion to the operating hours of the machine rather than to the passage of time. For example, the quantity of power consumed is in direct relation to the operating time of the machine. Depreciation, although not incurred only when the machine is operating, does take place in a more direct relationship to the time the machine is operating. Rent has nothing to do with the time a machine is operating. However, it is a fixed element and may be accurately distributed under any plan. On the other hand, maintenance expense, which is one of the major elements of manufacturing expense, has a very direct relationship, as a rule, to the operating time of the machine. Oils and other machine supplies are consumed in direct proportion to the machine time, and for the most part the tool expense chargeable to the machine is incurred on that basis.

In the case of the factory administrative charges, they bear no direct relationship to the passage of time, direct labor hours, direct material, or direct labor cost, but in part relate to each of these factors. Therefore, administrative charges may be for the most part as equitably distributed on the basis of the machine time as any other plan.

In a plant where the work is performed largely by machinery, the machine hour rate plan will be more accurate than any of the previously mentioned plans. For example, in a plant using automatic or semi-automatic machinery where one machine tender operates three or four machines, the direct labor cost method would be very unsatisfactory.

**Method of Computing the Machine Hour Rate.**—Individual accounts are set up in the factory ledger for each production center. To these accounts are charged all expenses incurred in the operation of that center for the cost period including the operator's time. The total of the account for the cost center is divided by the number of machine hours of operation within the center. The result gives the rate for applying manufacturing expense against the total product of that center. To find the amount of expense to be applied against each individual unit of product, it is necessary to divide the total units of product for that production center into the total numbers of hours of machine operation on that product and to multiply this result by the rate.

**Advantages and Disadvantages.**—Management is interested in finding the cost of the product by departments with as great accuracy as can be economically secured. This plan enables the cost of the product by departments to be determined with a high degree of accuracy and in sufficient detail to make cost analysis a less difficult task. The plan is not in general use, even in concerns where it would prove more accurate than other plans, the major reasons being the difficulty of installing the method and the cost of operating it. Considerable preliminary work is required to install this method, and more clerical work is required to maintain it. Computation is more difficult and more records must be kept. In addition to the usual records, such records as the total machine hours by machines, and departments, and total machine hours for the entire plant must be kept.

**Department Method.**—The so-called department method utilizes a rate, based on one of the four methods already mentioned, for each productive department. It seems, therefore, incorrect to even classify it as a method of diffusion, inasmuch as all methods are based on departmental operations.

**Class Method.**—In some cases it may be desirable to diffuse manufacturing expense on the basis of classes of product. Where three or four products are manufactured, under identi-

cal conditions and processed by similar equipment, then, and only then, may a class method be used as a basis for diffusion. As a general rule the rate of diffusion for each class of product must be scientifically calculated.

**Production Center Method.**—This is similar to the so-called department method.

**The Unit Method.**—Under certain conditions the unit method of diffusion is ideal for absorbing manufacturing expense. Accurate rates can be determined per unit, per pound, per foot, or per gallon.

$$\frac{\text{Total Manufacturing Expense}}{\text{Total Number of Units}} = \text{Rate in Dollars per Unit}$$

Units may be worked out scientifically, where one product bears a definite relationship to another and may be translated in terms of equivalents of the other, assuming that all of the products require, fundamentally, the same service.

$$\frac{\text{Total Manufacturing Expense}}{\text{Total } x \text{ Equivalents}} = \text{Rate in Dollars per } x \text{ Equivalent}$$

*Example:*

Product No. 1	=	$x$
Product No. 2	=	equivalent to $1.5 \ x$
Product No. 3	=	" $1.75 \ x$
Product No. 4	=	" $2.0 \ x$
Product No. 5	=	" $2.25 \ x$

Assume the following production for the month of January:

1000 No. 1 products	=	1000 $x$ equivalents
1000 No. 2 "	=	1500 $x$ "
1000 No. 4 "	=	2000 $x$ "
		<u>4500 <math>x</math> "</u>

$$\frac{\text{Total Manufacturing Expense}}{\text{Total } x \text{ Equivalents}} = \frac{\$9000.00}{4500.00} = \text{Rate per } x \text{ Equivalent } \$2.00$$

**Process Method.**—This is similar to the other methods. The expenses are collected for each individual process and diffused to the cost of the products passing through that process on the basis of either units or hours of operation.

$$\frac{\text{Total Manufacturing Expense per Process}}{\text{Total Hours of Operation or Number of Products}} = \text{Rate}$$

It is the responsibility of management to select a method of diffusion which will be equitable in every respect; regardless of the method selected, however, there still remains the problem of over- or underabsorbed manufacturing expense to contend with. (See Chapter 30.)

#### **Managerial Considerations in the Selection of a Method.**

—The promptness with which the cost data are furnished to management determines in part the value of the data. Unless a method is selected which will expedite the dissemination of the periodic cost data, the management will not be able to make full use of the cost data. Failure to get the data out on time interferes with price quotations, bids on contracts, the making of monthly profit and loss statements, the preparation of the monthly balance sheet, and sometimes makes a material difference in the finance plans. For example, a job completed by the 25th of the month should be costed and the customer billed in the same month. Failure to get the costs before the end of the month holds up the monthly statements and also delays billing the customer until the following month, which permits him to take advantage of a longer period before paying the bill. Furthermore, the method of diffusing manufacturing expense must be considered in connection with other uses which management makes of cost data. Inaccurate or distorted costs are not to be relied upon as a sound basis for formulating policies or changing plans. If the distribution of the manufacturing expense is inaccurate or inequitable, the analysis of the cost of manufacturing will lead undoubtedly to the formation of wrong conclusions. Executive action based on such conclusions may bring wholly unsatisfactory results.

## CHAPTER 8

### DEPRECIATION AND ITS CONTROL

**Importance of Depreciation.**—The majority of business managers regard depreciation as one of the most important items of cost, and perhaps the one most neglected by cost accountants. There are two reasons why records of depreciation are vital to management: (1) to record the decreasing value of the asset caused by depreciation; (2) to include in the cost of the product, or products, the proper amount of depreciation for a given period. Depreciation represents the loss in value of capital in certain forms, due to use and other causes. No argument is advanced against the statement that capital in the form of buildings, machinery, equipment, and tools, diminishes in value even with the passage of time, but unfortunately, this fact is not always considered in relationship to the costs of manufacturing.

It may be that inability to determine definitely the exact amount of loss in value is responsible for its neglect, but it is equally as difficult to obtain exact measurement of other items which does not in general diminish the emphasis placed upon them.

The importance of depreciation should be fully appreciated in connection with the ruling of the Treasury Department (T.D.4422) and from the standpoint of preservation of invested capital. Failure to recognize the importance of the subject may be due largely to a lack of understanding of the methods utilized for determining the extent and amount of depreciation and its effects upon costs.

Most concerns are content to adopt the simplest methods of computing and diffusing depreciation expense over the cost of production, after assuring themselves that the procedure adopted will adequately protect the investment and operate most advantageously in tax matters.

Many persons regard the term depreciation as including or covering the loss in value of an asset from any cause whatsoever. It will simplify the discussion and perhaps will tend to avoid confusion if a distinction is made between depreciation and other terms which may have a similar meaning or are part of this broad subject.

**Definition of Terms.**—*Depreciation* is the loss of life or value of an asset due to use, abuse, wear and tear, the elements, or the passage of time.

*Obsolescence* is a term used to indicate the inability of an asset, usually a machine or building, to compete with a more modern or better adapted machine or building.

*Depletion* is the diminishing in value of an asset, usually property, caused by the removal of the valuable material inherent in that property. For example, the cutting of timber, extraction of oil or minerals from the ground.

*Inadequacy* is a term used in connection with plant and equipment to express the measure of inability of an asset, usually a building, a machine or piece of equipment, to meet the productive demands made upon it.

*Renewal* is a term used for the expenditures incurred in extending the life of an asset, usually plant and equipment, beyond its average life.

*Decrepitude* applies to plant and equipment when it is enfeebled or broken down by age.

*Exhaustion* represents the decline in reproductivity of an asset, or a decline in quality, quantity, or strength of an asset, and usually applies to animals, vegetation, soil fertility, or water supply.

*Amortisation* is the liquidation, extinction, or reduction of a debt, in whole or in part, by means of a sinking fund.

*Supersession* is the replacement of plant or equipment which has lost its usefulness because of depreciation, obsolescence, or inadequacy.

*Appraisal* is the evaluation of an asset.

*Residual Value* is the remaining value of an asset, usually plant and equipment, after depreciation and/or obsolescence, have been incurred.

*Salvage Value* is the value of an asset for other purposes than that for which it was originally purchased.

**Theory of Depreciation.**—Underlying the practical treatment of depreciation is the fundamental theory of investment. This theory states that an investment should be made to return a yield in the form of interest and that the principal must be so safeguarded that it will remain unimpaired until withdrawn. A considerable portion of the investment in a manufacturing concern is represented by machinery, buildings, and plant. Proper maintenance and repair of these assets prolong their life, but eventually they become valueless for the purpose for which purchased. As the value of the plant and equipment becomes less through use, etc., it is necessary, at stated periods, to set aside from income an amount, or create a reserve, equal to the loss in value of the assets, that at the time they become valueless there is a fund, or reserve, on the books of the company equal in amount to the original cost of the machine, building, or plant. Thus, when it becomes necessary to replace the asset, the funds for replacement may be available, and no part of the original investment has been impaired.

**Depreciation Policies.**—The theory and principles of depreciation can be definitely stated, but many practical problems are bound to arise in connection with making decisions as to policy and procedure of applying these principles. It seems that each company must formulate its own policies relating to depreciation based on the factors which apply to that individual plant. Such factors must be considered as the kind and types of buildings and equipment; their mechanical and structural design; the type of products manufactured; the age of the structures and equipment; the type of maintenance and repair services; the general condition of the plant as a whole; the possibility of obsolescence and inadequacy; the amount of investment in the physical plant; and the state and federal regulations which apply to depreciation.

All executives who are interested in costs and production problems must analyze this problem of depreciation and be responsible for seeing that the cost of the product manufac-



tured absorbs an amount of depreciation equal to the loss in value of plant and equipment. Manufacturing costs must not be distorted by wild guesses of the amount of depreciation which is chargeable from period to period. Such costs may reflect unfavorable results in a highly competitive market.

**Causes of Depreciation.**—The following may be considered as the major causes for depreciation:

1. Wear and tear
2. Negligence
3. Defective maintenance service
4. Structural defects
5. Atmospheric conditions
6. Limited use of facilities
7. Damage
8. Abuse
9. Deterioration

**United States Treasury Decision 4422.**—The United States Treasury Department has issued a decision in connection with depreciation which has had a far-reaching effect on industry and the records kept covering plant, equipment, and depreciation. Article 165 of T. D. 4422 is well-worth reproducing here for the information of business men in general.

ART. 165. Method of computing depreciation allowance.—The capital sum to be recovered shall be charged off over the useful life of the property, either in equal annual installments or in apportionment of the capital sum over units of production. Whatever plan or method of apportionment is adopted must be reasonable and must have due regard to operating conditions during the taxable period. The reasonableness of any claim for depreciation shall be determined upon the conditions known to exist at the end of the period for which the return is made. Where the cost or other basis of the property has been recovered through depreciation or other allowances no further deduction for depreciation shall be allowed. The deduction for depreciation in respect to any depreciable property for any taxable year shall be limited to such ratable amount as may reasonably be considered necessary to recover during the remaining useful life of the property the unrecovered cost or other basis. The burden of proof will rest upon the taxpayer to sustain the deduction claimed. Therefore, taxpayers must furnish full and complete information with

respect to the cost or other basis of the assets in respect of which depreciation is claimed, their age, condition and remaining useful life, the portion of their cost or other basis which has been recovered through depreciation allowances for prior taxable years, and such other information as the Commissioner may require in substantiation of the deduction claimed.

### Essential Features of T.D. 4422.—

1. The burden of proof is placed squarely on the taxpayer.
2. The previous official tables of depreciation rates are obsolete.
3. Schedules must be filed showing the following:
  - (a) Original estimated life in years.
  - (b) Rate of depreciation.
  - (c) Year acquired.
  - (d) Original cost and subsequent additions by years, including current year.
  - (e) Deductions for sales and other dispositions in prior years.
  - (f) Adjusted cost beginning of year.
  - (g) Credits to depreciation reserve, prior years.
  - (h) Charges to depreciation reserve, prior years.
  - (i) Depreciation reserve beginning of year.
  - (j) Balance remaining beginning of year.
  - (k) Estimated remaining life.
  - (l) Deductions for sales and other dispositions current year.
  - (m) Adjusted cost end of current year.
  - (n) Depreciation claimed for current year.
  - (o) Charges to depreciation reserve current year.
  - (p) Net depreciation reserve end of current year.
4. The allowable depreciation is based on conditions known to exist at the end of each tax period.
5. The remaining useful life must be reconsidered each year.
6. The effects of operating conditions are recognized for each tax year.
7. The taxpayer will be assessed for deficiencies in taxes on past returns unless convincing evidence is produced by him.

8. The rates may be varied from period to period, provided the taxpayer adequately supports the claim.

9. The grouping of assets and the allocation of costs on depreciation schedules must be carefully considered.

10. Where plant and equipment records are not available, or in poor shape, an appraisal is required and necessary records must be established and maintained.

The gist of the act places the taxpayer in a position where he must conclusively substantiate his entire depreciation schedule. Depreciation is a managerial problem, requiring knowledge and practical judgment. It is based on the useful value of plant and equipment.

**Rate of Depreciation.**—As previously pointed out the Department of Internal Revenue does not recognize a set rate of depreciation for computing income tax returns. However, the following figures are usually accepted as a guide to management in formulating its annual rates for a few important items of plant and equipment.

Buildings: brick  $1\frac{1}{2}$ -2%; cement  $1\frac{1}{2}$ -4%; steel 3%; frame 5%.

Boilers: 5-6%. Furnaces:  $3\frac{1}{2}$ -10%.

Blowers and Fans:  $5-6\frac{1}{2}$ %. Compressors:  $4-6\frac{1}{2}$ %.

Lighting Systems: 4-12%. Switchboards: 5-6%.

Piping:  $3\frac{1}{2}$ -10%. Pumps:  $4\frac{1}{2}$ -6%.

Factory Trucks: 12-15%.

Conveyors:  $8-9\frac{1}{2}$ %. Belting: 4-18%.

Welding Equipment:  $10-12\frac{1}{2}$ %.

Generators: 3-5%.

Automobiles: 15-25%. Trucks: 15-18%. Electric Trucks: 10-12%.

Machines:  $5-12\frac{1}{2}$ %. Rolling Mill: 5-7%.

Patterns: 16-25%.

**Methods of Estimating Depreciation.**—In general, the method of computing depreciation consists of estimating the useful life of the asset in years, and dividing the number of years into the installed cost of the asset, so as to determine

the portion of cost which is applicable to each year or period. In practice the majority of all business concerns use the straight line method of depreciation, as it is simple to calculate. Many of the other methods require a great deal of calculation and records and possess few obvious advantages. Each method has some good point, yet not one of them appears to be the ideal method. The ideal would be one which permitted the making of a periodic charge against the cost of the product, and a similar amount credited to a reserve account which would equal the exact value by which the asset has decreased during that period. It is impossible to estimate the exact life of the asset, or even to predetermine accurately the rate of actual decrease in its value. Therefore, all factors should be carefully considered in order to establish an estimated rate.

The factors which enter into consideration when estimating the rate of depreciation and life of an asset are: cost of the asset; mechanical construction, including materials; service to be performed; conditions under which service is to be performed; expected maintenance and repair; federal and state regulations; and residual value.

**Straight Line Method.**—This method is perhaps more generally used than any other method. The simplicity of operation, lack of mathematical computation, the minimum amount of time required to compute amounts, etc., make this method desirable. The method consists in estimating the life expectancy and residual value of the asset, and dividing the cost less residual value by the estimated life in years to obtain the amount of depreciation to be charged to manufacturing expense.

*Example:*  $V$  = Original installed cost = \$1400.00

$V^1$  = Residual value = 200.00

Cost of useful life = \$1200.00

$n$  = Estimated life expectancy ten years

$x$  = Cost of asset to be absorbed in 10 years, or \$120.00 per year

Monthly depreciation \$10.00

$$\text{Formula } x = \frac{V - V^1}{n}$$

**Reducing Balance Method.**—This method intends to establish a relationship between the amount of depreciation and cost of repairs in order to equalize the charge made against the product. A constant percentage rate of depreciation is determined and applied to the cost of the asset for the first year and the same rate is applied to the annually reduced value each subsequent year during the estimated lifetime of the asset. Thus, the amount of depreciation is high the first year, and reduces each succeeding year until the asset is fully depreciated. Opposed to this is the increasing repair cost which it is assumed will counterbalance the reducing annual charge of depreciation.

This method is perhaps no more accurate than other methods, but it does attempt to establish a relationship between the amount of depreciation and amount of repair cost, which will make the total costs of manufacturing more uniform.

*Example:*

$$\begin{aligned}
 V &= \text{Cost of equipment installed} = \$2300.00 \\
 V^1 &= \text{Residual value} = 150.00 \\
 &\quad \text{Cost of useful life} = \underline{\$2150.00} \\
 n &= \text{Estimated life 10 years} \\
 x &= \text{Annual Rate of depreciation} = 25.1
 \end{aligned}$$

$$\text{Formula} = x = 1 - \sqrt[n]{\frac{V^1}{V}}$$

The great disadvantage of the use of this method is that it places a heavy burden on production costs the first few years, although this is offset to some extent by low cost of repairs during that period.

**Sinking Fund Method.**—This method employs the usual sinking fund principle in its operation. The annual charge for depreciation is a constant, and the rate is somewhat lower than the straight line method rate due to the fact that the sinking fund interest is added to the amount in the fund.

**Production Method.**—This method attempts to relate the rate and amount of depreciation to the output of the plant. Although several factors enter which make for uncertainty and

change of rate, the theory is apparently grounded on a sound basis. The rate of depreciation is lower and the total depreciation charged is higher during periods of normal activity than when the plant is operating at subnormal output. In the latter case the rate for each unit of output is higher, but the total amount of depreciation is lower. This plan tends to distribute more equally the cost of depreciation over the cost of the output. The uncertainty of what the output will be during a future period is the outstanding objection to the use of this method.

An adaptation of the production method is to compute a rate of depreciation based upon the productive hours of machine operation. This method makes no provision for idleness of the machine or differing rates of speed in operation which may affect actual rates of depreciation.

There are other methods less used and more complex, such as the annuity plan, compound interest plan, equal annual payment method, and the machine hour method.

**Management's Interest in Depreciation.**—The management of a manufacturing concern is interested in the subject of depreciation for many reasons. A few of the major ones are stated below.

1. To safeguard the invested capital through adequate reserves.
2. To select a satisfactory method for estimating depreciation.
3. To make depreciation a part of manufacturing costs.
4. To meet provisions of federal and state tax laws.
5. To aid in financial operations.
6. To assist in the fixation of certain responsibilities.
7. To provide for plant valuation and appraisals.

In the last analysis, depreciation is the diffusion of the cost of the useful life so that the consumer of the product will pay for the asset, and the original investment will be kept intact.

The interest of management in selecting the method for estimating and accounting for depreciation is to be certain that adequate reserves are set up, and that no undue expense is placed upon manufacturing. Furthermore, management is interested in seeing that the costs of computing and recording

depreciation are not excessive; that the accounting treatment prevents distortion of manufacturing costs; and that the method of treating the subject is fair to department heads and executives. Where the law is not a prime factor as to choice of method, the character of the business, the assets to be depreciated, and the interest of the executives in the subject will determine the method employed.

**Distribution of Depreciation Expense.**—The usual way of distributing depreciation expense over various departments is on the basis of the cost of machinery and equipment in the department. Where the machine hour rate method is employed for diffusing manufacturing expense, each individual piece of machinery and equipment in a department may be taken as the basis. Where the process method of cost accounting is employed, all the machines or equipment concerned with one process represent a unit, and the amount of depreciation of this unit is charged as such to the process.

The depreciation of buildings is made the subject of a department charge based upon the area of floor space occupied by a department.

**Importance of Depreciation in Appraisals.**—The factor of depreciation plays an important part in appraising the plant and equipment to determine its present value. If sufficient depreciation has not been written off, a loss may be sustained in a sale of assets, and where excessive depreciation has been written off, it may prevent the making of a consolidation or merger, or cause undervaluation of the plant. The cost of replacement must also be considered in connection with the above subject. While it is not possible to determine the future replacement cost at the time the equipment is purchased, the subject should be given some weight in setting rates of depreciation.

**Effect of Depreciation on Departmental Expenses.**—Management places responsibility for departmental operation on the individual in charge of the department. To a large extent the department head's success is determined by his ability to keep

his departmental costs in line with predetermined estimates. Where depreciation constitutes a large part of the departmental expense, he may be unfairly judged. Economy in various ways may have been effected under his direction but may be more than offset by amounts of depreciation charged against his department. The reducing balance method recognizes this fact, and attempts, by reducing the annual charges for depreciation, to offset otherwise increasing cost by assuming that as the life of the equipment becomes less, the cost of maintenance will increase in inverse ratio to the decreasing depreciation. Actual depreciation due to controllable causes for which the department head should be penalized is many times ignored.

Management must realize that although the cost of depreciation is being returned in income from sales that it has the duty of prolonging the life of the assets as far as profitable.

**Reducing Actual Depreciation.**—A few of the factors which may assist in reducing the actual depreciation are proper care of machinery and plant, prompt and adequate repairs, periodic inspection and maintenance, careful and thorough instruction to machine operators, and proper adjustment of machines for the particular class of work. Some authorities claim that a definite and measurable relationship exists between depreciation, repairs and maintenance. They contend that this relationship should be established and used as a guide in determining future rates of depreciation, as well as in checking the department heads and the activities of the engineering, repair and maintenance departments. In most plants this information would not be available by individual machines. In some cases, depreciation is computed for a group of machines rather than individual machines but this practice is frowned upon by authorities.

**Value of Equipment Records.**—In one plant, the equipment card for each piece of equipment in the plant shows the original cost, date of purchase, name of manufacturer, and other technical information concerning the machine. On the reverse side of this card the rate and amount of depreciation are kept in one column, while in a second column all repair, maintenance, and



## EQUIPMENT RECORD CARD

CLASS OF EQUIPMENT \_\_\_\_\_  
DESCRIPTION \_\_\_\_\_

NUMBER \_\_\_\_\_

NEW ☐ OR SECOND HAND ☐ (CHECK WHICH)

MAINT. SHOP ORDER NOS. \_\_\_\_\_

ESTIMATED LIFE \_\_\_\_\_ YEARS, PROBABLE SCRAP VALUE \$ \_\_\_\_\_, DEPRECIATION RATE \_\_\_\_\_ % PER YEAR, OBSOLESCENCE RATE \_\_\_\_\_ %  
ESTIMATED DEPRECIATION CHARGES PER YEAR \_\_\_\_\_ MONTHLY RESERVE FOR DEPRECIATION \_\_\_\_\_

DATE	VOUCHER OR SHOP ORDER NO.	DESCRIPTION OF ITEM (COST, ADDITIONS, ETC.)	COST	LOCATION OF EQUIPMENT:		FLOOR	DEPT.
				PURCHASED FROM	MEGR		
10/2/37		FIRST COST (PURCH. ORDER NO. ) FOUNDATION	25 000 00	DATE TAKEN OUT OF SERVICE	MEGR'S SERIAL NO.		
		INSTALLATION (DATE IN OPERATION)	1 200 00	AMOUNT REALIZED \$	SCRAPPED <input type="checkbox"/> OR SOLD TO		
		FREIGHT AND TRUCKING	800 00	FLOOR SPACE OCCUPIED: NET SQ. FT.	GROSS, INC. NET CLEAR	SQ. FT.	
			75 00	WEIGHT	LBS.	HORSE POWER	MONTHLY WORKING HRS.
				MACHINE HR. RATE	RATE	DATE	
				EST. SCRAP VALUE	WEARING DEPRECIATION VALUE	REMAINING VALUE	RESERVE FOR DEPRECIATION COSTS
		TOTAL INITIAL COST	27 075 00	200 00	26 875 00		
10/14/37	✓ 256	AUTOMATIC HEAD	500 00		500 00		
			27 575 00		21375 00		
		TOTALS					

Figure 17. Equipment Record Card

replacement of parts cost are entered. From an examination of these equipment cards, management can determine with reasonable accuracy the advisability of replacing a particular machine. Likewise, the desirability of making extensive repairs on a machine can be more accurately determined. Figure 17 shows a suggested equipment record card.

It happens frequently that a machine will wear out before it is fully depreciated, or it may last much longer than expected and be fully depreciated with much usefulness remaining. This is purely an accounting problem and is solved in numerous ways. The importance of this problem is in connection with the actual value of the asset to a going concern in case of valuation for sale, and its effects upon costs of manufacturing.

**Reserve for Depreciation.**—There seems to be some misunderstanding as to the nature of a depreciation reserve. It is confused with funds set aside for the replacement of fully depreciated plant and equipment, but since the reserve is usually set up on the liability side of the balance sheet, or as a deduction from the assets on the asset side, it does not represent a fund and is not an appropriation of surplus. It is merely a book reserve set aside for the replacement of worn-out plant and equipment, due to depreciation.

**Obsolescence.**—Obsolescence is an individual matter. That is, it is confined to a single plant, machine, or building and as a rule cannot be anticipated. It is subject to measurement when it occurs, but not before. Obsolescence does not of necessity involve loss. In fact, no loss should occur except a theoretical book loss. Unless the introduction of a change or a new invention shows a saving in some form over the existing machine or building, it is obviously not desirable to make a change.

Some authorities on the subject of depreciation suggest that obsolescence may also be regarded as the gradual loss in value of an asset due to normal progress of science made in the field the asset serves. This phase of the subject may be more properly called inadequacy, for not all concerns are at the same point in output at the same time, and where more modern buildings or machines are required by one producer,

another who has not reached that stage may utilize the plant and equipment which is obsolete for the first producer.

Where it is desired to make provision for possible obsolescence, the usual practice is to add a certain amount to the rate of depreciation on the machine or building and make no division of the account. This extra rate of depreciation may or may not be sufficient to offset the cost of obsolescence when it occurs, but the plan is favored by many accountants.

In cases where a plant is constructed or machines designed and built for a specific purpose, and economic conditions or the enactment of laws bring about the disuse of that product, then obsolescence occurs and may be written off according to law which usually will not permit of it otherwise until the obsolescence occurs. For example, plant and machinery designed specially for the manufacture of alcoholic beverages were forced into disuse by law. Where these plants or parts of them were not convertible to other uses, the law permitted the writing off of a certain amount as obsolescence, between the time the law was enacted until it became effective.

**Measuring Obsolescence.**—The importance of this subject to management is to be able to calculate in money the value to the business of new inventions or changes, so that when obsolescence occurs it can be accurately measured. A machine which is obsolete to one producer may not be so to another whose requirements may be better met by the so-called obsolete machine. In measuring the amount of obsolescence the management makes a comparative statement. On one side appears the purchase cost of the new machine, cost of installation, estimated cost of operation, estimated output, cost of operator, cost of maintenance and repair, estimated life, and fixed and variable charges. Opposed to this are set up the original cost of the old machine installed, amount of depreciation written off, estimated balance of life, and cost of repairs during the period, estimated cost of operation, operator, estimated output and rate, cost of making change, that is, delayed production, etc., and scrap value of the old machine. These opposing factors are studied, and where possible they are weighed against each other

in terms of money and output to assist in determining the amount of obsolescence.

In addition to these factors, which can be more or less accurately measured, there are many other considerations which might make the change desirable. For instance, the space requirements of one versus the other machine might more than offset a saving. The rate of output might be the determining factor. Even though the cost of output may be greater, a faster rate of output might overcome a point of congestion. Adaptability of the machine to other work, changes in power supply, accident prevention, or change in the character of labor requirements, must be given proper consideration when the question of obsolescence arises.

**Inadequacy.**—Many accountants fail to differentiate between inadequacy and obsolescence. Likewise, some regard inadequacy as a part of depreciation.

*Inadequacy* is a separate subject, although obsolescence in the generally accepted meaning of the term, and depreciation in all cases may bring about inadequacy. For example, machinery that has suffered 50% depreciation may not be capable of producing as much product as could be disposed of. The result is inadequacy, the cause is depreciation. Likewise, depreciation may be intensified and hastened by inadequacy. For example, if a greater demand exists than can be met by operating the machines at a normal speed and for a normal daily period, the machines may be speeded up in order to turn out sufficient product to meet the demand, thus increasing their actual depreciation.

Inadequacy in another sense may be brought about by consolidation, mergers, etc. For example, a consolidation of three companies manufacturing similar lines of products took place, and due to better marketing methods the demand for the products of one plant was so increased that this plant was inadequate to meet the productive needs of the sales department. On account of this and the condition, age, and location of the plant it was decided that it would be more economical to build an entirely new plant in a more favorable locality rather than

attempt to overcome the inadequacy of the old plant by expensive additions to it.

It has been pointed out that the extent of inadequacy cannot be anticipated with certainty, yet many concerns annually set aside a reserve for contingencies as a financial provision for excess depreciation, obsolescence and inadequacy. The general accounting practice approves the making of provision for a certain amount of inadequacy, even with the recognized uncertainty of its future existence.

**Cost of Inadequacy.**—It is not possible to figure accurately the cost of inadequacy. The fact that a demand for increased output exists and the evidence of the permanence of the increased demand and the profits to be made by supplying it are conclusive enough to warrant plant expansion. The failure to undertake the expansion will mean the loss of the estimated profit, and this loss is, therefore, the estimated cost of inadequacy. For example, a machine has a capacity of 100 units daily, and evidence is at hand to warrant the statement that the trade will absorb 125 units daily. The machine is inadequate to supply the demand. If a change is not made which will permit the production of 125 units daily, the net profit on the 25 units represents the cost of inadequacy.

**Managerial Importance of Inadequacy.**—The subject of inadequacy is of great importance to the management, inasmuch as it plays a significant part in policy formation, determination of plant and equipment needs, selection of plant location, planning for expansion, and the predetermination of profits. The war brought to light many cases of inadequacy, with the result that plants expanded to such a point to meet wartime demand that after the war period ended, they found themselves in possession of facilities much too great to supply normal demands. This is an abnormal case, but more recent instances could be cited to show the cost of overanticipating inadequacy, and also where greatly reduced profits resulted from failure to meet inadequacy when it arose.

**Greater Attention to Problem.**—Prior to the World War period, depreciation was given but little attention. The intro-

duction of federal and state income tax laws focused attention on the subject, and the uncertainty of income tax law interpretation and the instability of income tax rates have kept management interested so that it can take the greatest legitimate advantage of sudden changes or new interpretations of the law. In this endeavor, the true problem of depreciation has been overlooked, or at least neglected. Now, with the law greatly clarified and rate changes less frequent, business managers must give attention to the real problem of depreciation as it affects margins of profits and competition.

The problem is to establish a method for estimating rates of depreciation which will be in close relationship to the actual depreciation that is taking place, and to establish an accounting procedure for charging depreciation against manufacturing costs in such a way as not to cause fluctuations or distortion of cost figures.

## CHAPTER 9

### THE RELATION OF ENGINEERING TO COST CONTROL

**The Engineer.**—The introduction of scientific management in business has done much to increase the prominence and importance of the engineer. His work has always been to utilize the forces of nature in such a way that they supply human wants and needs, but within recent years he has come to assume a large share of the responsibility in the other great divisions of human endeavor, namely, those of leadership and direction of human energy. During the past twenty-five years management has been deeply indebted to the skill of the engineer. He has used scientific methods in solving the many and difficult management problems that have arisen from time to time. In fact, the science of management had its origin in the work of the engineer. There is scarcely an industry that one can think of which does not reflect the skill of the engineer in some form or other. Today industry demands a vast number of men skilled and trained in the science of engineering to cope with many technological problems which arise from consumer demand of streamlined products and the technological development in industry as a whole.

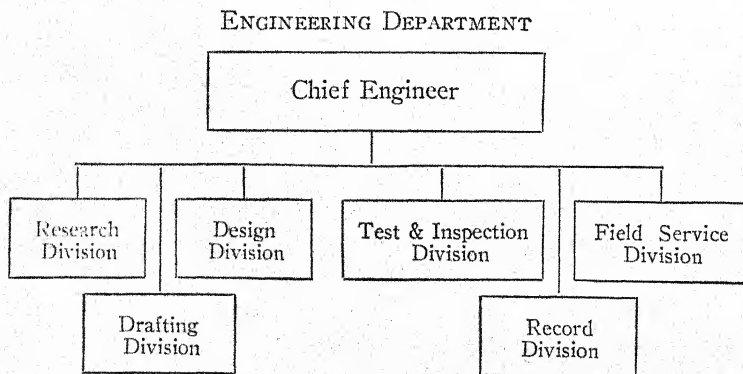
In his strictly technical field the engineer deals with the physical, electrical, mechanical, and chemical sciences in the experimenting and development of products and processes. In the wider field which is opening to him, he must deal with the problems of applying, directing, and regulating the expenditure of human energy. These are the problems of applied economics which the engineer must master. The intense application of machinery to bring about our present era of mass production and distribution has not only added complexity to the work of the engineer but has opened to him an ever broadening field of opportunity. It is the engineer who lays the foundation

for all cost work. His blue prints, operation sheets, and designs pave the way for the cost accountant. The engineer estimates the costs of processes, operations, parts, and products long before they go into production. Because of the complex process of manufacturing and mass production the modern cost accountant should be a graduate engineer.

**Engineering and Cost.**—It is difficult to conceive the effects of engineering activities on the cost of production. Each phase of this work has a direct bearing on the cost of raw material, labor, operations, processes, and the product itself and for this reason a careful study must be made covering the engineering activity, that means, the organization of the unit, the activities of each of its subdivisions and the work performed by each individual within its organization.

Take for instance the subject of design, which is one of the major activities of the engineering function. Mr. Ford is reputed to have spent \$33,000,000.00 to change the design of his car from model "T" to "A". This illustrates the importance of the relationship between the engineering and cost.

**Organization of Department.**—The engineering department is under the supervision of a chief engineer, who is responsible to the general manager. It is subdivided into six major divisions, each headed up by a responsible person, usually an engineer, reporting to the chief engineer, as follows:





The engineering department is sometimes referred to as a staff department and sometimes as an operating or line department. It partakes of the characteristics of both. Much of the work is of an advisory nature. For example, the selection of materials, process, and tools is advisory in theory although in general practice the department issues orders in regard to the materials to be used, and processes and tools to be employed in fabricating the product and the operations through which the product will pass in its fabrication. Many times the issuance of orders by the engineering department is merely a shortcut. In theory these orders should be issued by the general manager or factory manager upon the recommendation of the engineering department.

**Cost Based on Drawings.**—The basis of all manufacturing costs is the mechanical drawings, showing the raw materials to be utilized and the operations to be performed in turning out a finished product. It is the drawing which forms the basis for the analysis of costs and for this reason, cost accounting and engineering must be very closely allied in their activities.

Engineering cost estimates are used by management as standards to measure operating activity and cost of performance. It is again the engineer who by his data sets up the basic foundations for standard costs.

**Functions of the Engineering Department.**—The advent of science in business has measurably increased the use of engineering in manufacturing. It has placed the stamp of its approval upon engineering by bringing about a fuller realization of its importance and has added materially to the functions of the engineering department in a manufacturing plant. The machine technology of this age makes it incumbent upon engineering to design, invent, improve, and perfect products to be manufactured and sold.

Scientific management has added the functions of research, experiment, service, planning, and the working out of manufacturing processes and operations, selecting and specifying the materials to be used; determining the amount and establishing the points, kinds, and methods of inspection required to uphold

the quality standards of products; and lastly, management demands that the engineering department prepare blue prints, specifications, parts numbers, and lists and plans for machine layouts and product assemblies. All these activities have direct bearing on the cost of the product and must be carefully watched.

The specifications for the raw materials and the quantities of these raw materials to be consumed in each product are the bases for direct material costs. The operation sheets showing the operations to be performed on the product form the basis for direct labor costs. All changes in these factors affect the cost to manufacture.

**Engineering Department Cooperation.**—The unique character of engineering work places this department in an unusual position to render cooperative service to the other activities of the business. For example, in connection with the sales department it can render substantial cooperation in the reduction and elimination of customer complaints; in answering customer inquiries, objections and criticisms, training of salesmen in the construction, use, and maintenance of the products; in working out new designs, uses and packing of products, and in the development of new products. Equal opportunities exist for engineering cooperation with manufacturing, inspection, and purchasing which will help to promote more efficient operation of those departments. Again it is pointed out that these services affect costs.

**Engineering Service to Manufacturing.**—A major portion of the work of planning and scheduling production and the actual fabrication of the product must be based upon the data supplied by engineering. The plant layout, manufacturing plans, changes in equipment and new designs of products are also work of the engineering function, in which the manufacturing department is vitally interested. The special problems of manufacture in a particular concern will determine to some extent the engineering services required. However, in most cases, the following data will be supplied in addition to such other services as may be needed:

1. **TO ASSIGN PART NUMBERS.** Each part, whether purchased or manufactured should have a part number assigned to it so that it may be readily and accurately identified. The engineering department should keep a record of all assigned part numbers, giving a complete description of the part, the assemblies in which this part is used, and a copy of the drawing which represents the part. Where the part is a casting, the pattern number and type of metal should be given. If the part is a forging, then the die number should be shown. A part must retain its original part number regardless of the various assemblies in which it is used. If any changes are made on the part, then the original number with a dash one, or other symbol, should be assigned to this revised part. For example, part 2101 has had a slight change in design; the part number now becomes 2101-1. If a second change is made, then the part number becomes 2101-2. By the use of this system, one can readily identify the part and know immediately that there have been two changes made in the original drawing.

2. **TO CONSTRUCT PARTS LISTS.** A parts list is a list of the constituent parts of which a completed product is made. This list should reveal the part number of each individual part, the name of the part and the quantity of each part required in the completed assembly. These parts lists should be provided for the manufacturing, production control, and cost accounting departments.

In checking the detailed compiled costs of a product, such as a large turbine, the parts lists are utilized by the cost accountant to check against the cost sheets, to determine whether or not all the parts required have been accounted for on the cost sheets. In many cases the material requisitions are checked against the parts lists by the cost accountant, again, for the purpose of verifying withdrawals from stores for the specific production order.

3. **PREPARE AND SUPPLY DETAIL DRAWINGS.** A drawing is a representation of an object on a plane surface made by lines. A detail drawing should show the exact shape and size of the part, give all dimensions, allowances and other require-

ments and show the description and quantity of the raw materials from which the part is made.

These drawings are used by the cost accountant to check the type and quantity of raw materials withdrawn from stock for each product manufactured. They form an excellent basis for determining and controlling waste in productive operations.

Defective products returned by customers should be carefully checked with the detailed drawings, so as to determine the defective parts, the raw materials from which it is made and the material purchase specifications for that particular material.

4. PREPARE AND SUPPLY OPERATION SHEETS. An operation sheet shows the exact operations or processes in sequence, through which each part or assembly must pass in production. An operation sheet must be prepared for each individual part or product which is to be manufactured and should show the name of the operation, the department or division in which the work is to be performed, the type of the machine performing the work, jigs, fixtures, gauges, tools, tooling instructions, time consumed in operation, inspection required, description and quantity of the raw materials required per piece, the number of pieces to be manufactured on the order, and the final inspection and disposition of the finished part or product.

Here, again, the cost account utilizes these operation sheets to check the time element or the productive labor consumed in producing each product. They also provide a basis for determining and checking the costs of each individual operation, the efficiency of each operator, and the idle and waste time. The operation sheets provide a basis for checking the inspection and tooling labor costs for each operation.

5. PREPARE AND SUPPLY MATERIAL SPECIFICATIONS. A material specification gives an exact description of the material, its dimensions, and in some cases its chemical and physical analysis. These material specifications are of the utmost value to the purchasing department in buying materials, and to the manufacturing activity in that they insure the procurements of the best materials for the specific purpose. The buyer is in a

position to purchase to definite requirements and upon receipt, the material can be inspected and checked against the specifications. By the use of material specifications a wider field of sources of supply may be developed and all vendors are able to bid on the same basis. Technical or engineering specifications should be compiled for every item, whether it be a paper clip or a carload of sand.

Carefully drawn material specifications will aid in a variety of ways to reduce costs and prevent waste. A material specification is a standard of quality for the material and standardization is an agent of cost reduction.

**Divisions of Engineering Department Activity.**—A fair-sized engineering department will be usually subdivided into divisions of activity based upon the character and extent of the different classes of work carried on.

**1. Design.**—The work of design is further subdivided into its two classifications, namely, design of product and design of machinery, tools and equipment.

(a) **PRODUCT DESIGN.** The work of designing the original line of products together with all subsequent changes, improvements and new products is done by this division. The work is of maximum importance since the design of the product to a certain extent will regulate the volume of sales and will also have a substantial effect upon the volume and cost of manufacturing. The design division must, therefore, give most careful consideration to the needs, problems and possibilities of manufacture and the cost of producing certain products as well as considering the designs of the product from the standpoint of its desirability, utility, and power to satisfy the needs or wants of customers and to compete with similar products. The study of new uses for present products; the development of by-products and new products to round out or balance the manufacturing line is also a part of the work of this division. It must work in close harmony with the purchasing department as to the cost, availability, and supply of materials; with the finance division as to advertising, manufacturing, and marketing, costs of introducing new products, and with all other divisions of the

engineering department in such ways as will best promote the maximum efficiency of the department.

(b) MACHINE DESIGN. The improvement and standardization of existing machine design and the development of new machinery and tools constitute an important activity. Changes in the supply and cost of materials, the character, supply, and wages of labor and the demands of customers make it necessary to be constantly adapting the machinery to the needs of the production. Likewise, the activity of competitors in the more economical production of merchandise provides a strong stimulus to the invention, perfection, and improvement of machinery in order to maintain a standing as an economical producer of quantity and quality merchandise. This activity must function in close cooperation with other divisions of the department and with the operating, maintenance and all other departments. Before adapting a new or changed machine design, it is necessary that all factors affected be considered. For example, the inventory of materials, supply of parts on hand, personnel required to operate the new machine, cost of producing, maintenance, power and tools required, effect upon production schedules, and many other factors must be carefully analyzed to determine the advantages or disadvantages of making the change.

2. Research and Experimental Division.—Research work in the average industrial organization is carried on primarily to benefit the particular business. Only in the very large industrial concerns is there a research laboratory which delves into a scientific field for the purpose of contributing to the general fund of scientific knowledge.

The work of this division concerns itself mainly with the development of new materials and products; the experimenting with and testing of existing materials and products; the analysis and testing of competitive products, experimental machine development, chemical analyses, and development of process formulae. The research division offers invaluable services in connection with cost reduction by examination of parts, processes, operations, and equipment and determining whether or

not improvements can be made in these factors, or if certain changes in machine or part design will reduce the cost of manufacturing. From research along these lines it may be possible to discover new materials which will act as substitutes for materials already in use. These substitutes may be much more economical to purchase, thus reducing the cost of raw materials. Changes in design and the elimination of certain parts and operations will also aid considerably in reducing direct material and labor costs. Research to discover and develop allied products may help in a program of cost reduction, by the utilization of scrap materials for these allied products or by decreasing capacity idleness by the utilization of idle plant and equipment for their manufacture. By increasing the volume of production there should be a decrease in the unit cost of the product. The research division has many practical opportunities to render service to other departments and may be quite helpful to the sales department through the analysis of competitor products and presenting the comparative findings to the sales manager for the information of his selling force.

**3. Field Service Division.**—The major work of this division is to render mechanical and advisory service to customers where the nature of the products require it. Machines may fail to operate satisfactorily after installation, breakdowns may occur, or the customer may require advice on the operation, use, or care of the product. The men assigned to this work are trained or skilled engineers or mechanics specially qualified to perform this work. Field engineering must not be confused with sales engineering which is a part of the sales department. This latter work consists of rendering technical or advisory service to prospective customers for the purpose of interesting them in the purchase of new equipment.

(a) **INSTALLATION.** Many concerns manufacturing heavy or intricate mechanical or electrical equipment provide an installation service as part of the sale. The work of installation of such products is carried on by the field service division. After the product is installed a test is run or a final inspection is made to determine if the installation work was properly performed

and if the machine will do the work for which it was sold. This insures the customer of a properly installed machine ready to operate and is a provision against defective installation and subsequent damage to machine or product from this cause.

This division can render substantial service to manufacturing and inspection in overcoming weaknesses and defects in design or manufacture of products and can increase customer good-will, stimulate sales, and reduce customer complaints through its activity in the field; all these factors have a bearing on cost.

**4. Inspection and Test Division.**—The final test and inspection of manufactured products is carried on by this division. Many types of products require final inspection or a final test after they have been assembled to make certain that they are properly adjusted. For example, pumps, generators, motors, automobiles, and many other products are given a running test, speed test, strength, stress or strain test, or are operated to observe horsepower developed, power consumed, vibration, and friction. Many of these tests are made in the manufacturing plant while many are made after the product is installed on the customer's premises, in the latter cases this test is performed by the field service division.

Such inspection or tests may prevent defective products from being placed into the hands of consumers and is an added guarantee of quality and satisfactory performance.

The inspection and test division is in a position to constructively criticize engineering design, manufacturing processes, operations, and to offer helpful suggestions regarding materials used, methods of assembly, etc. The work of the test and inspection division must not be confused with the work of inspecting the raw materials, parts, and assemblies, which is the task of the inspection department.

**5. Drafting Division.**—The engineer makes a sketch of the part or product on which is shown dimensions. This sketch is given to the drafting room where it is reproduced to scale as an original mechanical drawing. After the drawing has been carefully checked, it is next given to a tracer who traces the



drawing on tracing linen. From this tracing one or more blue prints are made. A new development in this particular line has recently been placed on the market. The drawing is made directly on the tracing paper, in pencil, and no inking is required, thus saving a large portion of cost in the elimination of tracing labor.

Blue prints are distributed to the persons concerned in the production of the part or product, copies are also given to the production control unit, cost department, and other interested activities.

The drafting division also assigns parts numbers and maintains such files of drawings, blue prints, parts lists and numbers as may be required; and renders assistance to the engineers in checking specifications, provided the draftsmen are qualified to perform this highly important task.

**6. Record Division.**—Because of the great mass of records required by the engineering department it is considered desirable to set up an independent unit to take care of this phase of the work. It is usually headed by a chief clerk, who is under the authority of the chief engineer, and is responsible for all records of the department.

It should be remembered in addition to the various opportunities for cooperation pointed out, that the engineering department serves in an active capacity as a guide, advisory council, and service unit to the operating organization. It clears the way for operations, assists in ironing out problems which arise in the manufacturing departments, and works in close co-operation with sales, production control, cost accounting, and the time study divisions. The engineering activity is a direct and valuable aid in cost compiling, cost analysis, cost estimating, detection of waste, and control of waste.

## CHAPTER 10

### THE RELATION OF PRODUCTION CONTROL TO COST CONTROL

**Need for Production Control.**—The problem of every manufacturing industry is to gear its rate of production to conform with the rate of sales consumption of finished products. In those industries which produce a varied line of products and several types within a line, the problem becomes one of great difficulty. Even in simple type industries producing only one line of standard products this synchronization of manufacturing and sales is a difficult task. If a concern is producing both for stock and to customers' orders the problem is even more complicated. It is unprofitable to have idle plant facilities and machines, or men only partially occupied. Similarly, it is unprofitable to have an excess of capital tied up in a large inventory of finished goods which may move slowly, become obsolete, or damaged before they are sold. At the same time competitive standing in the consumer field cannot be maintained if promised delivery dates are broken, if shipments to customers are delayed, or if the salesman always finds it necessary to tell his customers that his company does not have a particular article in stock at the moment.

On the other hand, if manufacturing activity can be dovetailed with sales needs for finished goods, the minimum amount of capital is required for the purchase of raw materials, labor requirements can be more easily supplied, plant capacity can be more effectively utilized, the costs of production can be substantially reduced, and the work of the sales department becomes less difficult and more efficient.

While a system of production control will not accomplish all of the desired ends, it will be of great assistance in their attainment. It is easy to understand how orders may get sidetracked,

machines may not be fully utilized, idle capacity may go unnoticed, or partially idle labor may result in a plant which does not have a definite plan for its manufacturing activities and for keeping track of all work to be started or in process. The old axiom that work well planned is half performed is true, but it might be well to add an important phrase, "at half the cost." The need for a system of production control and for the application of the principle of planning is just as evident and as real in a mercantile, banking, or other type of business as in a manufacturing concern, and although the discussion in this chapter will consider the problem of production control in a manufacturing plant, the principles and methods discussed can be readily adapted to almost any type of business.

#### **Extent to Which Production Control Should be Carried.**

—The statement has been made elsewhere in this book that every result should be measured in terms of its cost and in the determination of the extent to which an individual concern should carry production control, the cost and value of its use must ultimately determine the answer. This is the only universal principle which cannot be challenged, although there are other considerations which in most instances should receive the attention of executives in deciding upon this question. There are in most plants some factors, physical and otherwise, which may limit the extent to which any plan can be carried, regardless of the necessity for its extension or the desire of its sponsors to widen its field of application. In a continuous process type industry, manufacturing one single line of standard products, there would be little need for more than master planning and results control. The very nature of the products and processes, the limiting physical factors of equipment, processing methods, and machine capacities might definitely establish the limits to which the system could be extended. On the other hand, a factory doing either a job order or production for stock business and manufacturing several lines of various sizes of types of articles, might find it profitable to extend the production control system beyond the stage of master planning and plan in detail the production of each item or article by individual or groups of machines, or by departments or processes. Even

where the system could be so widely and no doubt profitably used, the policies of the management, the character of the executive and supervisory personnel, tradition, politics, or other factors might limit its application to the principle of master planning only. The extent to which machinery, equipment, methods, and products have been standardized will be an influencing factor.

**Types of Production Control Systems.**—Out of the experience of business managers in their attempts to exercise varying degrees of control over production, two more or less distinct systems have been evolved. As a general rule, however, neither of the systems will be found in use in its pure state but will be modified to meet the requirements of the particular concern. The factors which determine the extent to which it should be carried will also control the type of system selected and the degree to which it is modified in a particular application. Where there is need for it, and a management who desires it, the centralized system may be installed. It provides broadly for the control of each step in the production process, from the receipt of the engineering analysis of the sales order until the finished goods are released to the sales department for shipment to the customer. In this system a central planning department makes all arrangement for production, including the planning and scheduling of each part or product through the various stages of manufacture, its routing to departments and machines, and arrangement for the delivery of raw materials, tools, and work instructions to the various foremen at the time the work is planned to start. Thus the foreman is relieved of all planning in connection with turning out the goods and concentrates his attention on the supervision and leadership of his working force to see that they comply with orders and maintain progress schedules. Under this centralized plan, the production control division has its representatives placed throughout the shop. They are constantly tracing, checking, and reporting upon the status of each order in work. Through a system of reports common under this plan, the control office is kept constantly informed as to the progress of each order, the amount of work scheduled ahead for each machine or bench, the necessity for

extra effort, overtime work or other expedients, to enable the keeping of a promised delivery date. As a result, the plant can be kept working at a rate of speed designed to meet all sales requirements and to keep the cost of plant operations at a reasonable figure.

Under a decentralized type of control system, only master planning is performed by the control division and only group or total results are checked. All intermediate planning and checking are left to the foremen and supervisors in whose departments the work is being performed. When the engineering analysis of a sales order is received by the control division, the date on which the order will be released to the shop is determined, and the date upon which the order should be finished and released to the finished goods storesroom, or to the sales department, is calculated. In some instances the order is broken down according to the departments in which it will be manufactured, and the starting and completion date for the work of each is determined by the master planning section. In all cases foremen are responsible for intermediate planning, and in some cases are responsible for procuring the needed raw materials and tools from the storesrooms. The master planning section should always take the responsibility for seeing that the raw materials are in the storesrooms by the time they will be needed. If the materials are not in stores or on order at the time the job is received from the sales department, a purchase requisition is issued to the purchasing department for their procurement before the date the work is to be released to the shop.

From these illustrations of the two types of systems, it can be readily seen that either system can be carried to either extreme, or to any point between, according to the needs therefor.

**Organizing for Production Control.**—The reason for the failure of a production control system to operate is, in many cases, the lack of preparation. It is a time-taking and costly task to prepare a plant. Although in any case it involves no organization work that should not have been done in the past. Many executives feel that they can operate their concerns with-

out incurring this cost and so argue that production control is not satisfactory or is too costly to introduce. The more important factors to be considered in preparing a plant are briefly discussed below.

1. **THE PLANT LAYOUT.** The various departments or shops in which manufacturing operations are carried on should be so arranged that the flow of materials through processes, inspections, and assemblies is smooth, sequential, with the minimum amount of back-tracking or overlapping. The plan of layout must take into consideration also the requirements for supervision, the space needed in manufacture, lighting, heating, ventilating conditions, aisles and corridors for material handling, the need for temporary space for supplies of materials and finished parts, and many other similar factors.

2. **THE MATERIAL PROCUREMENT SERVICE.** Production cannot be easily scheduled or its steady flow through the shop maintained unless there is an adequate supply of suitable materials available. It is vital to the operation of a control system that the material procurement service be organized and operated so as to provide the quantity and quality of materials required in manufacturing by the dates specified by the control division.

3. **STORESKEEPING AND MATERIAL CONTROL.** Adequate examination and storing of materials when received and their prompt issue to the shop when required strengthens the procurement service and greatly facilitates production. Similarly, an accurate record control of materials enables the production control division to calculate requirements and to order or reserve materials for particular jobs well in advance in order to be certain that they will be on hand when needed. Maximum and minimum quantity of all materials required for production should be established on the basis of the varying volume of output. When a material reaches the minimum, it must be re-ordered through a purchase requisition. An accurate knowledge of quantities and class of materials on hand at any given time is of great assistance when changes in lines or types of products are being planned, or when the production of new or different products is contemplated.

4. MATERIAL HANDLING. The prompt and efficient handling of materials from storesroom into production and through the various stages of operation, inspection, and assembly into finished stores greatly expedites production, avoids delay, and aids in maintaining production schedules. If it becomes necessary to allow extra time between operations or at any stage of manufacture because of poor material handling service, the effectiveness of the control plan is accordingly reduced by that unwarranted loss of time.

5. QUANTITY STANDARDS. All other factors being equal, the rate of flow and the total amount of production which can be put through the plant in a given time will be determined by the capacity and condition of the machinery and equipment available for use and the rate of output of the machines and workers. Thus as a basis for planning production, scheduling the starting and completion time for parts or products, standards of output for each machine and each productive worker must be established and maintained.

6. ENGINEERING DATA. The connecting link between production control, manufacturing, and the various other services is the data furnished by the engineering department, which aids the control division in effectively utilizing the other service agencies and in planning for production activity. The data includes information relating to the type, quality, and quantity of materials required for each class of product, the operations and processes through which it must pass in fabrication, the quantity, dimensions, quality, and characteristics of parts required; the time, place, and nature of inspection required and methods of assembly, as well as other details.

7. QUALITY CONTROL. The control of quality which begins with the inspection of raw materials entering into the product and ends when the finished product has been finally approved for shipment plays an important part in the operation of the control system. The control of the quality of the materials entering into the product through their inspection upon receipt assures the control division that the available materials

are satisfactory; the control of the quality of the parts and products during manufacture reduces scrap and spoiled work and makes the work of assembly easier and quicker. In these, and many other ways, quality control facilitates more accurate production control.

8. THE SUPERVISORY AND EXECUTIVE PERSONNEL. It is impossible to operate a production control system without thorough understanding and hearty cooperation on the part of the operating personnel through which the system must function. In organizing for production it is an essential and primary step to win the endorsement and support of those who must ultimately be responsible for the extent to which the plan can be carried and the success with which it will work. It is sometimes a task of considerable magnitude to "sell" the idea to the "old-timers." In fact many of them cannot be convinced by argument or persuasion that such a plan will work or is desirable. In such cases a managerial policy must be declared, for it then becomes a question of dropping the idea or the obstructionists. To make a disciplinary matter of cooperation seldom brings satisfactory results and unless cooperation is given willingly and sincerely it is of little aid.

There are other steps in organizing for production control which it is not necessary to discuss here. A sufficient number of factors have been briefly considered to indicate the scope of the work involved in preparing the plant for adequate control. The question of plant maintenance, tool service, plan of organization, the cost system, the budget, and others, must be studied and all influencing factors welded together in a plan that will facilitate the smooth and uniform flow of production and the efficient conduct of the service and administrative activities.

The costs of production are inversely proportional to the effectiveness of the production control system. Where the system is poorly organized and inefficient, the costs will be higher than where a good and efficient system is maintained. Under a poorly organized system of production control, factory costs will be difficult to control and excessive wastes are bound to occur.



**Production Control an Effective Instrument for Cost Control.**—An adequate production control system is invaluable to management in its control of costs and in the analysis of the various elements of costs, but such a system cannot be established and maintained unless the following information and data are available.

1. Complete engineering data.
2. Complete information covering all types and classes of tooling required for production.
3. Complete inventories of raw material in stores, work in process, and finished stock.
4. Complete information regarding costs and times of all previous operations of parts and assemblies.
5. Complete information regarding power production and consumption.
6. Complete information regarding power, speeds, and feeds of all machines.
7. Complete instructions to supervisors and workers.
8. Complete instructions to inspectors, and the designation of the points where inspection must take place.
9. Complete system of records and following up of the schedule program.
10. Complete systems of maintaining the machines and equipment.
11. Complete cooperation between functions, supervisors, and workers.
12. Financial incentive for workers to increase productivity and increase the morale of the workers.
13. Complete cost accounting system to determine cost of production and control of waste.

The use of the above information for cost control purposes is illustrated in other chapters.

**Functions of the Production Control Division.**—From the standpoint of management and the determination of accurate costs, the production control division should be assigned definite duties and held strictly responsible for their perform-

ance. The scope of the duties are embodied in the following activities:

1. To be responsible for and have control over the flow of production through the plant from raw materials to finished products.
2. To plan all activities in connection with the flow of production, including operations, processes, machines, tools, material handling, and recording.
3. To make such time and motion studies as are required so as to establish standards of time, quantity, and economy for work, operations, parts, processes, assemblies, products, and costs.
4. To supply the proper materials and tools to the operators, machines, and processes as required for production.
5. To plan and maintain all work schedules.
6. To record all productive activity and check same with schedules.
7. To devise ways and means for reducing costs and eliminating waste.

**Steps in Production Control.**—After preliminary planning has been accomplished and the plant prepared for production, the control system must be developed and put into operation. The essential steps in the system are: routing, scheduling, and dispatching. A brief discussion of each will explain why no step can be omitted in establishing a definite control over the output.

1. **ROUTING.** The most economical manufacture of a product requires the accomplishment of each operation or process in its production at that stage in the cycle at which it can be most effectively performed. It is possible, for example, to drill a part first and then turn it in a lathe, but unless the most desirable sequence of operations has been determined, it does not follow that this sequence is correct, or the best. Therefore the work of routing must include the determination of the sequence of operations, the standard time necessary for each operation, and the machine or place where the operation must be performed. In deciding which operation shall precede or come after each

other operation, such factors as the nature of the product, the quantity and quality desired, the character of operations and personnel, machines, tools, and equipment available for work, layout of the plant, and many others, must be considered. The product itself must be carefully analyzed to determine the most desirable sequence and the least costly method of manufacture, all of which must be modified by limiting factors in the plant. The plan of plant layout, for instance, may be one limiting factor. The machines may be arranged so that all operations required on a part can be done in one shop or department, or they may be grouped according to their similarity. The type of machinery and equipment will also influence the sequence established. Special machines have certain advantages in some cases, but they are less flexible and cannot be used for as many different purposes as standard machines. The machinery, its characteristics, adaptability, and economy for each type of operation must be studied in the light of the products to be made.

The answer to these and other questions will permit the assignment to each part or product a sequence of operations which is best suited to existing manufacturing conditions to produce it in the quantity and quality desired at the lowest consistent cost.

2. SCHEDULING. Scheduling is the time element in production control. It is the determination of the time at which each operation or event in connection with manufacturing will take place. If the operation of the control system is decentralized, the work of scheduling by the central planning department is carried no further than the determination of the approximate time work shall start in a given shop or section on a specific part or order. The detailed scheduling of the work within that shop or section is left entirely to the foreman. If the system in operation is of the centralized or mixed type, the work of scheduling will include the determination of the approximate time each piece of work will be started on each machine, or at each work place. In this latter case the detailed scheduling is usually handled by a schedule or dispatch clerk stationed in the shop or section for which he is doing detailed scheduling.

*Phases of Scheduling.* There are three primary phases of the scheduling procedure:

- (a) *Master Scheduling:* The assignment of dates on which important events in production will take place or products will be completed.
- (b) *Operating Scheduling:* The assignment to a given machine or process, the total time required to perform a certain piece of work or assembly.
- (c) *Detail Operating Scheduling:* The assignment of the necessary time for each individual job or operation performed by an operator, machine, or within a process.

3. **DISPATCHING.** This phase of production control includes the issuing of work to the shops and its follow-up to see that routes and schedules are lived up to insofar as shop conditions will permit. In some instances the work of dispatching consists merely of sending to the various shop foremen work orders and instructions for work to be performed in their respective shops and in receiving production reports of progress.

In other instances dispatching includes the releasing of material requisitions, the issuing of work tickets and recording upon them the starting and finishing time of work; preparing and issuing move tickets to guide the handling of work in process, issuing identification tickets for each lot or order; the operation of a machine activity board to show for each machine, work now in process; the next scheduled job and additional work scheduled for that machine; the preparation and handling of idle machine time cards for each machine; the handling of "in" tickets on which finished parts are sent to stores; and the handling of many other details. The task of adjusting schedules, sidetracking regular for emergency work, shifting work from one machine to another because of breakdown, lack of labor, tools, etc., arranging for the use of additional machines or overtime work in order to maintain schedules, and other similar problems are usually part of the responsibility of the dispatch section in conjunction with the time study division, the shop foreman and the scheduling section. In cases where the dispatch clerks are located in the shops which they serve and

the work of dispatching is not too great, they may also check the workers "in" and "out" clock cards against the job tickets in order to facilitate the preparation of the payroll. Where this phase of timekeeping is a part of the dispatch clerk's responsibility, he functions under the joint control of the timekeeping section of the cost accounting division and the production control division. Clearly if the work of routing and scheduling is to be of any value it must be made effective through the careful dispatch and close follow-up of work, to see that routes and schedules are maintained, or where conditions will not permit this, to determine and put into effect the best adjustment.

### Time Study

**The Field of Time Study.**—In its restricted meaning time study refers to the observation of the performance of work of an individual or machine for the purpose of determining the time required to complete the performance of each element of an operation or task. When given the broad significance which is generally attached to it in practice, it includes the analysis of working conditions under which a task must be performed, the analysis of the task, the standardization of the job, the establishment of time standards for the man or machine, the standardization of method, and in many instances recommending changes in motions or the sequence of operations and the use of different tools, machines, or processes.

Thus the field may be broadly divided into four distinct parts. The first includes the preliminary study and analysis of working conditions, materials, machines, tools, and methods which lead eventually to job and method standardization, the second includes the actual observations of the time required for the performance of each element of the operation or task, the third part includes the establishment of the standard operation time for the man or machine, and the fourth includes those activities connected with establishing standard pay rates and incentives.

**The Purpose of Time Study.**—The effectiveness of the production control system is largely a matter of correct routing,

accurate scheduling, prompt dispatching, and close follow-up of all work. In each of these activities the work of time study plays an important part and serves a distinct purpose.

It is, however, entirely possible to operate a production control system without the aid of time study work but its effectiveness is substantially reduced and the benefits usually derived from its operation are materially lessened. Similarly it is possible to set piece rates and to standardize work methods without the aid of time study but the results in such cases are usually much less satisfactory than when based upon scientifically found data. Thus it is seen that the purpose of time study is to assist in the standardization of jobs, to serve as a scientific basis for the determination of the best method of performing work, to insure the accurate determination of the performance time for men and machines, to facilitate the work of production control, to act as a sound basis for the development of wage plans and incentives, and to make possible the accurate determination of labor costs.

**Preparation for Time Study.**—In the broad preparation for time study work, essentially the same factors must be considered as are discussed on page 165 of this chapter under the heading "Organizing for Production Control." It is especially important that the time study section pay particular attention to the education of the supervisory and working personnel. The supervisory force must understand the purpose and advantages of job standardization, time observation, time standards, and must be willing and interested in giving full measure of cooperation to the section in preparing the ground for the actual time observations and setting of standards. The manner in which time study work will aid the foreman in obtaining a higher standard of production, reducing the spoilage, maintaining a better morale among his employees, and in exercising better control over his departmental operating costs, and other advantages of the work should be brought to his attention in order to arouse his interest and stimulate his desire to cooperate and further the work. Similarly it may be necessary to convince the workers that analysis of method and time observation of their work is not intended as a managerial check-up for disciplinary

purposes but as a means of improving their efforts and increasing their earnings through greater output, less waste, and better working conditions.

**Motion Study.**—This phase of the broad subject of time study refers to the observation and analysis of the motions made by an individual or a machine in the performance of each element of an operation or a task. The purpose of studying the motions made by a machine operator or a bench worker is to determine whether or not the best method of performance is being used, so that labor effort may be conserved and costs reduced. It is frequently the case that the method used is one that has been acquired through experience or has been taught by one who knew only that method. In many such cases the skilled analyst will find it possible to eliminate unnecessary motions, combine others, rearrange the position of materials, tools, or the sequence of motions to speed up the work, increase its accuracy, or reduce the fatigue involved in its performance. Similarly he may find that different tools, fixtures, or materials could be advantageously used, the sequence of elements or of the operation changed or the particular task combined with one or more other tasks in order to fully utilize the operators' time. After the method of performing the work in the one best way has been determined and accepted by all concerned as the standard for that task or operation, the observation, to determine the time required for the completion of each element of the job, may be started.

**Taking the Time.**—This phase of time study consists in the preparation of the time study sheet and the actual recording of the time for the elements of each operation. The time study sheet shows all pertinent information concerning the operation and the machine, and other facts which may be helpful in the subsequent analysis of the observations. The actual taking of the time is accomplished by the analyst who stands near (usually to one side) of the operator and records with the aid of a stop watch the elapsed time for each element of the operation, or records in successive columns on the sheet the continuous elapsed time according to elements. This appears to be a

simple task but it requires considerable skill on the part of the observer to secure accurate time and to observe during the progress of recording the time observation, any unusual conditions which may result in abnormal cycle or element times. In some instances only one observation of each element is made and in others a great number are made. As a rule about ten observations will give as accurate results as will a greater number. Sometimes an operation study is made to verify previous standards and in such cases a full day may be given to observing the time of one operation or in exceptional cases the observations may extend over a period of ten days in order to include a week-end and take into account conditions or happenings during that time which may have some influence. During the course of the observations the observer makes records on his sheet of changes in speeds or feed of the machine or other conditions which affect the average time. He seldom selects a poor worker or an exceptionally skilled one on whom to make his observations since for the most part the average skilled worker will be more representative and the standard set as a result of observing the average worker will be more useful.

**Establishing the Standard.**—This phase includes the analysis and study of the cycle times observations as a means of determining at what point the standard should be set. Clearly the minimum or maximum will not be satisfactory and it may be so with the average. A satisfactory method is to compute the modal average of all the observations. Before the standard can be set the abnormal times and their causes must be considered, and when necessary, allowances must be made for changes in machine setup, sharpening of tools, personal needs of the operator, rest periods, and other factors. In some instances greater allowances must be made than in others and no standard time allowance can be set except where all operators are performing the same work on the same kind of machines and under similar conditions. In setting the standard the time study man reviews all the facts, computes the allowance, and may discuss the subject with the foreman of the shop in which the study was taken before passing the data along to the time study engineer with his recommendation as to what the standard for



the operation should be. Before the standard is made official it must be accepted by the foreman whose leadership and efficiency will, to some extent, be judged by the collective performance of his employees, in comparison with the standards set. It is important that standards be accurately set and not changed unless there is an excellent reason for so doing. If they are set too loosely workmen will not be required to do a full day's work in order to earn their pay and if they are too tight it will be so difficult for the operators to earn their full amount that they may become dissatisfied and quit if the standard is not changed or may spoil too much material in an effort to make the standard. It is not good practice where the standard is not right to change the incentive rate to counterbalance a wrong standard.

The operation should be restudied and the methods reanalyzed in an effort to make changes that will correct the standard or the rate without the necessity for directly changing it. Of course when new conditions arise, new materials are introduced, or different tools or fixtures are used, the operation must be reanalyzed and timed for a new standard.

**Rate Setting.**—The fourth important purpose of time study work is to provide a sound basis for establishing wage rates, incentives, and labor costs. It is the responsibility of management to fix the base wage and to decide upon the incentive rate for each job. The time study division, the foreman, and possibly the worker or his representative (in the case of union labor or where there is an employee representation plan) may be called upon for suggestions and consulted in this connection. The time study division concerns itself primarily with the determination of standard times and standard rates of production and is seldom authorized or permitted to talk in terms of wages or incentives with the workers or foremen. After they have set the time and output standards, the management grades and classifies all tasks, decides upon the base rate, and the incentive to be offered in order to stimulate the workers to meet or better the standard set for a particular task. The amount of the incentive whether in the form of a piece rate, bonus, or other

PAY COUPON							
CLEAR _____ RECEIVED EARNINGS FOR WEEK ENDING							
NO. _____							
Signed _____							
Address _____							
No. _____		Street _____					
City _____		State _____					
HAVE ADDRESS FILLED IN BEFORE PAYMASTER ARRIVES IF THIS CHECK IS LOST, NOTIFY PAYMASTER'S OFFICE AT ONCE							
WEEK ENDING							
NO. _____							
NAME _____							
DAY	MORNING		AFTERNOON		LOST OR OVERTIME		TOTAL
	IN	OUT	IN	OUT	IN	OUT	
Days Absent _____				Times Late _____			
Total Time Lost,				Hours	Minutes		
Total Extra Time,				Hours	Minutes		
Approved _____							

(Face)

SUN.	MON.	TUE.	WED.	THU.	FRI.	SAT.
OVERTIME PASS: GOOD ONLY FOR DAY PUNCHED OUT						
NO. _____						
NAME _____						
Tear off and retain this coupon. Sign and hand to Paymaster as receipt for pay						
<b>THIS SIDE OUT</b>						
NO. _____						
NAME _____						
Each employee shall punch <b>ONLY</b> his or her own card.						
No record, other than the clock imprints, is permitted on the card.						
The noon hour is always to be recorded whether the employee remains in the building or goes out for lunch.						
P. P. W. H.				TOTAL		
P. T. W. H.				E. T.		
N. T. W. H.				GUAR.		
TOTAL						
RATE				AMOUNT PAID		

(Reverse)

Figure 17 a-b. Employee's "In and Out" Card

(Courtesy of Dodge-Markham Co.)

plan must correspond closely to the accomplishment desired. Its effectiveness as an encouragement to the worker and as an economy to the business will depend largely upon the quality of the standard upon which it is based and the care with which it is determined.

## CHAPTER 11

### THE RELATION OF WAGE SYSTEMS AND INCENTIVES TO COSTS

**The Importance of Wages.**—From the viewpoint of the employer, the subject of wages has come to be regarded as of major importance in the successful and profitable operation of his business. In the past, this view was not held and employers generally followed the policy of low wages and long hours and were wholly indifferent to such important matters as working conditions, hazards of employment, security of tenure and many other essential matters influencing the satisfaction and contentment of the workers. The workers having little or no savings were obliged to depend upon their daily earnings for subsistence and not having organized themselves were unable to successfully bargain with the employers to obtain a satisfactory wage and oftentimes not even a subsistence wage. The situation in the present industrial era is entirely different. Employers realize that much of their success depends upon their ability to secure and maintain a satisfied, efficient, and stable working force. Experience has taught them that low wages do not stimulate workers to maximum effort and that both quantity and quality of output suffers, discipline is weakened, the essential cooperation necessary to smooth functioning of the business is missing, and that carelessness and indifference increase the amount of avoidable waste and cause the cost of operations to rise considerably. The average industrial worker must rely wholly upon his wages for the necessities of life, to permit him to support and care for his family and as a means of securing the comforts consistent with his standards of living, and to enable him to make some provision for illness, accident, and unforeseen disasters. The worker is a member of the social group and his individual welfare is generally the welfare of the group.

The employer in his policy of wage payment profoundly influences the social welfare of his workers and the community of which they are a part. If he pays starvation wages, the health, morals, birth and death rate, and other aspects of the social life of the community are adversely affected.

Moreover, in adopting such a policy he does injury to his own interests. Starvation wages invariably influence the supply of labor, its skill, ability, endurance, interest, loyalty, and attendance, all of which tend to reduce output, increase spoilage and the difficulty of maintaining quality. Each of these factors causes an increase in the cost of output. On the other hand, high wages attract the best quality of labor, increase the regularity of attendance, stimulate the interest and loyalty of the force, and from the social point of view, permits them to give greater attention to their physical, mental, and moral development. The advantages of the high wage policy to the employer, the employee, and the community are so great as to argue strongly for it as the most economical policy to follow.

**Fixing the Wage Policy.**—The average business executive is unwilling to express his wage policy in blank terms of the law of supply and demand. He feels that a more comprehensive statement of the policy is desirable to guide him. He realizes that there are certain economic factors in connection with the subject of wages, which he, as an employing member of society, must consider before adopting a wage policy. Thus he attempts to enumerate and clarify in simple definitive terms those factors which influence the supply of available labor and which determine his demand for labor. He recognizes that there is frequently a demand price for labor set by the worker and also a fixed limit to the available supply over which he has no control. Thus he gives consideration to these factors and their influence in determining his policy. The employer considers his position in relation to labor and vice versa. He determines his demand and evaluates his offering price for labor in terms of: (1) established wage rates in his plant; (2) working conditions; (3) wage rates paid by his competitors and the going rate paid in the community; and (4) commodity price levels and purchasing power of wages. The attitude of the individual employer

regulates the extent and nature of the consideration given to this subject.

The term "standard of living" eludes definition except in the case of an individual and it is practically impossible for an employer to give individual consideration to each of his workers in this matter. He, therefore, resorts to a grouping classification which means he sets an imaginary standard that he believes to be the actual average of a homogeneous group, and upon this average he bases his consideration of the wages or their purchasing power in terms of the necessities, comforts, and conveniences included in this standard. The writers are of the opinion that in the future, employers will make a more serious attempt to arrive at a fair and liberal standard to use as a basis in setting the wage and in keeping it adjusted to fluctuations in the purchasing power of the money wage. Such an attempt is now being made by many large concerns in which the base wage is adjusted periodically in case the prices of commodities (considered as the components of the standard of living for the group) rise.

There are many instances in which the employer does not have the opportunity or freedom he desires in fixing his wage policy. In certain labor unions, the bargaining power of the employees is greater than that of the employer and they consequently dictate the wages that shall be paid to them and the number of hours they shall work. In cases where the supply of such labor can be restricted by the union it is possible for it to maintain this supremacy in bargaining until its desires urge it to demands that force the price of the commodity or service to such a point that the employer ceases to make a profit.

At this point demand for the product falls off, operations are curtailed, and unemployment follows unless the wages can be lowered to the point that will permit a return to a selling price that will move the normal output, and yield a profit to the enterpriser. The strength of the union consists in the number and cohesiveness of its membership, the particular trade in which its members are skilled, the number and availability of non-union men skilled at this trade, the mobility of labor, and many other factors.

Similarly the effectiveness with which the employer may bargain is restricted by such factors as the importance and value of the services in relation to the product produced, the rates of wages now paid for similar types of skill in his community, the location of his business, the volume of his profit, the competitive conditions under which his commodity is marketed and perhaps the nature of the business, and amount and character of the capital investment.

In determining what scale of wages he should pay and in fixing his wage policy, the average employer considers many factors of a general nature and many that are peculiar to his community or particular business. He realizes that beyond the factors which he considers is the principle of supply and demand expressing itself in terms of the public demand of products, the skill and capacity of management, the improvement of methods, improvement of technology, the number of producers, and the capacity of their productive equipment. The employer knows that the total number of workers (in the U.S.A.), immigration laws and social movements, the extent and character of labor organizations, the skill and experience of the workers available, the time and cost of training workers, their habits of living, general economic conditions, and many other factors that affect the supply available to him.

**The Value of Financial Incentives.**—The costs of operating a business fluctuate widely but not in ratio to the volume of its output. The cost of production is influenced by many factors, some of them directly controlled by the employer and many of them only indirectly within his control. In this latter class comes the skill of the workers, their willingness and application, their concern in protection of the company's interests in matters of waste of materials, spoilage of work, abuse and mishandling of machinery and tools, idleness, lateness, absentism, and leaving their jobs, all of which cause production costs to fluctuate. It is not to be expected that payment of the going rate of wages for that community will give the employer control of these factors, neither is a higher basic wage sufficient to give him a lasting control.

Moreover, a difficult problem arises if the employer attempts to reduce wages when they become a burden. Thus, in order to protect his own interests and to properly stimulate his workers, the employer must pay a fair wage to all and an extra reward for exceptional merit. This enables management to increase, decrease, or suspend the extra reward according to the accomplishment of the worker. This requires the worker to earn the reward before he receives it. The extra reward or incentive should be based on special activities, accomplishments, or conditions that the management wishes to emphasize; such as extra volume of output, low rates of spoilage, or reduction in costs of certain work. To avoid the impression that the company is in position to pay a higher normal wage, it must be clearly explained to the workers that the incentive paid is their share in the savings produced by their extra effort for which the incentive is offered. Incentives are employed oftentimes not as a means of stimulating extra effort in some direction, but as a form of insurance to guarantee that normal effort or standard performance will be maintained.

**The Value of Non-Financial Incentives.**—Experience has demonstrated that the use of financial incentives are more effective when combined with those of a non-financial character. High wages alone do not compensate the workmen for unfair dealings, lack of sympathy, injustice, or dishonesty on the part of the management. The highest standard of employee morale and satisfaction is obtained through the use of the financial incentives and such non-material rewards as proper selection and placement of workers, satisfactory working conditions, expressed appreciation of good work, courteous treatment of employees, good leadership, personal contacts, cooperation of supervisors, steady employment, a fair promotional system, adequate instruction, training, and education of workers, employee service and representation, and many other non-material and semi-material incentives which thought and interest of the management can develop.

**Characteristics of a Good Wage System.**—A good wage system must satisfy the requirements of both management and

employees. The former desires the system to be definite in its terms; simple and easy to operate; flexible enough to permit necessary adjustments based upon fair standards of accomplishment, standards of living, working conditions, and competitive wages. The employees desire a wage that is directly related to the effort put forth; that recognizes individual merit; that is based upon those factors which take into consideration hours of work, working conditions, output, loyalty, willingness, standards of living, and others. They also insist that the wage plan must be easy to understand, simple to calculate and prompt, regular, and direct in its payment. There is no single wage system that is suitable for use by all concerns and most times there is no single system that will be sufficient for the needs of a particular concern. Such a variety of conditions prevail, the types of work and workers are so different, the conditions under which work is performed, the need for greater or less stimulus, and many other factors vary so widely that it is usually desirable for a concern to employ two or three different plans of wage payment. From time to time different industrial leaders have proposed basic wage plans incorporating certain ideas which their experience led them to believe were essential in a wage plan. No one of these plans may be entirely suitable in a particular case but most of them are so flexible that any one of them can be readily adapted to the individual company needs, provided its basic premise is accepted.

**The Day Wage Plan.**—This is the oldest and perhaps the most widely used system of wage payment. In its earlier use it was characterized by the fact that time was the basis for the wage paid. The quantity and quality of the work performed were of less importance in fixing the wage than the length of the working day or the number of hours spent in the plant. In cases where the employer could exercise great care in selecting and training the workers and could maintain a high grade of supervision, he frequently profited by paying a time wage through securing greater production than the wage justified. However, these cases were comparatively few and for the most part the time wage in its early use resulted in loss to both the employer and the worker. Workers desire recognition of their



individual merits and expect that their efforts and accomplishments will greatly influence the amount of wages received. Those who are properly trained and skilled for their tasks, willing to give honest effort and loyalty to the company, rightly regard it as unfair to themselves to be placed on a wage equality with those workers who have less training, who cannot accomplish an equal amount of work, who are lazy, indifferent, or careless, and who are not sufficiently interested in the work of the company to help it progress. They quickly assume that their efforts are not appreciated and adopt the attitude and habits of the worker for whom they have no respect or else leave the company to find employment where their qualities will be recognized in the pay envelope. The straight time wage is in disfavor today and is used only in those cases where it is based upon a definite standard of individual performance; where supervision and the selective process are very thorough; where the work is mechanically paced, such as on a chain assembly line; or in those cases where the nature of the work is such that quality is paramount and an incentive might cause a sacrifice in quality. For example, as in the case of a toolmaker where accuracy and precision are more important than quantity of output. Some employers justify the use of the time wage plan on the ground that the nature of the work or the variety of duties performed make it impossible to establish definite standards of performance as a basis for a different wage plan, as in the case of information clerks, some accounting work, and a great deal of executive work. In such cases, the careful selection of personnel and the quality of the supervision must be relied upon to overcome the usual disadvantages of the day wage plan.

**Effect on Cost.**—Under the day rate plan of wage payment, labor costs will fluctuate widely, because a worker's output is not consistent. The volume produced per hour will vary with each worker and even the individual workman's volume of production will fluctuate from hour to hour.

These fluctuations of individual and departmental output complicate the scheduling of production, the movement of materials, and the assignment of inspectors. Time is lost, facilities are not fully utilized, and the costs of various elements of

manufacturing are thereby increased. For these reasons a plan based on an hourly rate is not satisfactory from a cost standpoint, particularly in those manufacturing plants where the margin of profit is small and the standardization of cost is an important factor.

Where the price per hour for labor is higher than that paid by a competitor, then the employer incurs a decided competitive disadvantage in his labor costs.

**Measured Day Work Plan.**—The plan combines some of the salient features of the hour and piece rate systems. Mr. R. H. Rositzke<sup>1</sup> describes the plan as one which fixes hourly wage rates by setting uniform base rates by occupations and by giving added inducements determined separately for each employee on the basis of four factors: productivity, quality, dependability, and versatility. An important feature of the plan is that employee's performance is judged over a relatively long period—not less than a month, and preferably three months; the result will be more constant earnings for the employee.

In terms of wages paid, measured day work is made up of two parts—the base rate, and additional compensation based on performance.

In determining the base rate, all jobs are evaluated independently of wages. An attempt is made to determine the relative standing of all occupations in the plant. After these relationships are established, the base rates are set by taking into consideration prevailing community wages, labor conditions, company policy, and the like.

After the base rate is set, the additional compensation is determined for each employee on the basis of performance, quality, dependability, and versatility. The opposition of organized labor to some of the current systems may mean that this plan may be widely used in industry.

An analysis of the fundamentals of the plan reveals that it is designed to stabilize production by stabilizing individual output. This in turn will have a beneficial effect on manufacturing

<sup>1</sup>R. H. Rositzke and T. Turner, *Measured Day Work Training Skilled Worker*, Bulletin No. 107, American Management Association.

costs through the stabilization and possible reduction of labor costs and the development of better controls over other manufacturing activities.

**The Piece Rate Plan.**—This system provides that a workman shall be paid a fixed amount per unit of accepted work and most times it also provides a guaranteed minimum time wage as a matter of company policy or to comply with the state law. This latter provision is effective when a new man is being broken in on the job or when interruptions occur for which the worker is not responsible but which prevent him from producing sufficient units to equal his guaranteed minimum. It has a certain value in reassuring the worker that he will receive the minimum wage under any circumstances. It may invite lazy workers to reduce their efforts knowing that under any circumstances they will receive the minimum guaranteed wage, but the time study man and the foreman should quickly discover and correct cases of this nature.

Two important considerations arise in the use of this plan. First, the question of the standard of performance for the particular job. The most scientific method of arriving at the standard is through job analysis and time study. Estimates of hourly or daily production on a job based upon previous experience or pure guess are frequently used as the basis for setting standards. In some instances, where conditions have been stabilized and records of past performance are adequate and reliable they may be used in lieu of time studies, but an accurate standard is more easily established on the basis of time studies.

The second consideration is the rate to be paid per unit. A rate that is too low makes it necessary for workers to rush and consequently they cannot do work as carefully as it should be done. High rates of spoilage work, excessive wear of tools and equipment, dissatisfaction and quitting of workers are the common symptoms, where piece rates are set too low. On the other hand, when rates are set too high, the cost of manufacturing the product is increased, and frequently the volume of output falls off because some workers are satisfied to earn only enough

to meet their minimum requirements and will not exert themselves beyond that point.

An arbitrary decision by the management to lower piece rates that appear to be too high usually causes trouble with the workers. When rates are too low, they must be raised. When they are too high they must be lowered, either through improvement of the process or methods used, or by submitting the case to a committee composed of workmen and foremen for consideration. The piece rate plan is very difficult to put into effect, but it usually works out satisfactorily to the employer and workers when properly established. It is simple to operate, easy to compute, and permits the workers to figure their daily earnings. It offers to the individual worker who is willing and energetic, a chance to increase his earnings and encourages him to work steadily and accurately. It is an incentive to high quantity and standard quality for no money is paid for rejected work and very often the rate automatically changes to a lower scale if the amount of rejected work exceeds a given quantity or the rate may automatically increase if the amount of spoilage is less than an allowed amount. It must be remembered that a piece rate system cannot be installed and forgotten; where changes occur in methods, materials, techniques, tools, or other factors which influence performance, adjustment of rates or standards are necessary to take care of these changes. The rate clerk and time study man must, therefore, be constantly on the job, checking rates and studying methods for improvement and perfection in order to keep the piece rate plan operating efficiently.

**Effect on Costs.**—Under a wage system based on productivity, labor costs will be constant. The piece rate system is based on volume; a worker is paid a definite amount of money for each unit he produces which is accepted by the inspector. The piece rate system stabilizes the labor cost of the product, so that it is a comparatively simple matter to estimate the unit labor cost.

**The Halsey Premium Plan.**—This plan operates on the principle of a standard time for each task, an hourly rate of

wages for the time required to accomplish each task, a guaranteed day minimum wage, and a premium to the worker of a portion of the time saved when he accomplishes a task in less than the standard time. For example, a workman receives a rate of 60 cents an hour and his task time for a job is 10 hours. If he performs that task in 6 hours, he receives  $6 \times 60$  or \$3.60 plus a portion of the time saved which is 4 hours, the difference between the actual and the task time. The portion may be any amount agreed upon, say 25%. Thus he is awarded in addition to his \$3.60, pay for 1 hour at 60 cents or a total of \$4.20 for 6 hours' work or at the rate of 70 cents per hour. If he does not better the task time, he receives 60 cents an hour for each hour put in on the task. The premium on each job is calculated separately so if a worker fails to make a premium on one task, it does not affect his premium earned on another task.

The system appears to be similar to the day wage plan but differs in that task standards have been set and also in that the worker gets increased pay for increased production. It differs from the straight piece rate plan in that the rate of pay per piece is decreased as production is increased while in the former plan the rate usually remains constant. The incentive provided by this plan, where the time allowance rather than the premium is liberal, may produce substantial savings, but since they are shared by the worker and the company there is less temptation on the part of the company to cut rates and on the part of the worker or his labor union to complain about earnings.

**Advantages and Disadvantages of the Halsey Plan.**—The system is easy to install, simple to operate, requires but little clerical labor, and permits the workers to calculate their earnings readily. It offers an incentive to workers to greater accomplishment without penalties for failure and it encourages new and slow workers through guaranteeing a minimum day wage. The standards used in this plan are based on experience rather than accurate time and motion studies and without preliminary job standardization.

Thus standards will not be consistent because they are based upon previous performances of the same or other workers on the job without regard to changes in job conditions. This will result in excessive earnings for some workers and very low earnings for others. The plan makes it possible for supervisors and foremen to show partiality in task assignments, thus creating dissatisfaction. Furthermore, in the setting of new task standards, workers may kill time in order to get an easier task standard set.

Regardless of the important disadvantages of this plan, it is often used as a temporary expedient to arouse the workers' interest, accustom them to an incentive plan, and obtain greater production while careful time and motion studies and job analyses are being carried on as a basis for installing a more suitable wage plan.

**The Rowan Premium Plan.**—This plan operates upon essentially the same principle as the Halsey Plan. The task standards are fixed in a similar manner, the minimum day wage is guaranteed, and the premium is based upon the factor of time saved. It differs from the Halsey Plan in that it increases the hourly rate by a percentage which is the proportion of the time saved to the standard time. Thus, if the task time is 8 hours, the rate per hour 50 cents and the actual time taken to perform the task is 6 hours, the time saved would be 2 hours or 25% of the task time. Therefore, the workman's hourly rate would be increased by this percentage and in this case would become 62.5 cents an hour for the 6 hours of actual time required to complete the job. Thus, up to a certain point the Rowan Plan would offer the workman a greater incentive than the Halsey Plan after which the condition would be reversed. However, the Rowan Plan, being designed to protect the management from too loose standards, effectively limits the premiums as the factor of time saved increases and makes it impossible for the workman to earn two times his hourly rate. The premiums that can be earned under this plan are therefore more of an incentive in those cases where the task standard can be bettered by less than 50%.

The other advantages of this plan are approximately the same as those of the Halsey Plan while the disadvantages are more since the workman finds it very difficult to compute his earnings, the system is more costly to operate, and the fact that the plan operates to limit earnings of the workers as their production increases is not encouraging to greater effort on their part; consequently the plan seldom succeeds in securing the maximum volume of output. The lack of scientific standards as a basis for setting tasks is, of course, a serious drawback to the system but the restriction of earnings under the plan prevents loose standards from resulting in excessive earnings. •

**The Taylor Differential Piece Rate Plan.**—This plan is based upon the idea that the best way to increase production and lower costs is for the management to standardize all elements of the work and to establish standard tasks based upon scientific time and motion studies and job analyses and then to set piece rates on a differential scale, offering a high piece rate to the willing and skilled worker who can make or exceed the high task standards and a lower rate to the slow or less skilled worker who cannot make the standard. Thus, if the standard task was set at 50 pieces per day and the high piece rate was set at 10 cents per piece, the differential piece rate to be paid to workers not producing 50 pieces might be 7 cents per piece. Unquestionably, the higher rate will attract good men and stimulate them to put forth their best efforts to meet the high task standards but the penalty inflicted on the beginner or the slow man by the low rate which not only reduces his price per piece but his total earnings and the fact that no minimum wage is guaranteed will cause him to be dissatisfied and probably discourage him to the point of quitting. The major advantage to the management of this plan is the fact that it makes necessary a detailed and exhaustive job analysis, the standardization of working conditions, and the making of scientific time and motion studies. However, the time required and the heavy cost of securing and maintaining these highly standardized conditions are oftentimes regarded as a disadvantage of the plan, since the failure to rigidly maintain them will result in the dissatisfaction of the workers and the possible failure of the plan.

**The Gantt Task and Bonus Plan.**—This plan requires the same preliminary analysis and scientific time study work as in the Taylor Plan as a basis for the task standards. The principle of the plan is to guarantee a minimum day wage to the slow or inexperienced workers and to offer a bonus to the energetic and skilled worker who can complete his task in standard time or better. The bonus may be fixed at any percentage of the task time depending upon the character of the work and the amount of incentive needed to obtain high production. For example, if the task time is set at 6 hours, the rate per hour is 50 cents and the bonus decided upon is 25% of the standard task time. If a workman completed a task in 7 hours, he would receive 7 times 50 or \$3.50 for the task. If he completed the task in just the task time of 6 hours, he would receive \$3.75 because he is paid for the 6 hours at the rate of 50 cents per hour plus the bonus of 25% of the task time at the hourly rate.

It will be seen from the above that the workman who requires longer than task time to complete a task is not penalized and the workman who completes his task in task time or better receives the bonus, although he would receive no more bonus for completing the task in 2 hours less than task time than he would have received had he completed the task in only 1 hour, less than task time or just in the task time. However, the advantage of completing each task in as much less than task time as he can, is found in the total number of tasks he may be able to complete in one day or one week. If we assume that in the standard task time of 6 hours 10 units are produced, the cost per unit would be 37.5 cents. It will be noted from the illustrations that although the hourly rate changes in relation to the actual time spent on a task, the cost per unit remains constant for task time or better. This is an important consideration in the computation of the costs for each unit. The chief objection raised to the Gantt system is that the guaranteed minimum day wage may result in some workers slowing down their output on jobs that they do not care for and speeding up their work to get high earnings on jobs they like or which are more easy to perform.



The plan operates as a time wage for the slow or less skilled worker and as a piece rate plan with a sufficient incentive to bring forth the best efforts of the skilled worker.

**The Emerson Bonus Plan.**—This efficiency wage system requires that standard task times be set on the basis of scientific time studies and also guarantees to the workers a minimum day wage. The principal feature of the plan is that the workmen's bonus starts accruing when they have completed only two-thirds of their task and increases at an accelerated rate as the production approaches the task standard. If a worker betters the standard time, he receives not only his regular bonus, but all the time he saves at his hourly rate. The task standard is taken as 100% and the bonus begins when the workman has accomplished 66% of the task, at which point he receives his full day wage.

For example, assume the task time to be 8 hours, the hourly rate 50 cents an hour. In one week (the calculations in this system are usually made weekly) a workman puts in 40 hours. During this time, he accomplishes tasks for which the standard time is 40 hours. He receives for this work 40 hours at 50 cents or \$20.00 plus his bonus which in the case of 100% efficiency amounts, on the Emerson scale, to 20% of his earnings, which will be \$4.00. This added to \$20.00 gives \$24.00 for his total weekly earnings. Now, if during this week's work he accomplishes tasks for which the standard time amounts to 48 hours, he receives first his 40 hours at 50 cents, plus 20% of that sum, and in addition he receives the total time saved of 8 hours at his hourly rate of 50 cents, or \$4.00, which added to his \$24.00 gives him \$28.00 for his week's work. If during the 40 hours he accomplishes tasks for which the standard time is 32 hours, he receives only his actual day rate for the time he put in which would be 40 hours at 50 cents or \$20.00 for his week's work.

The Emerson Plan has no outstanding advantage except perhaps the fact that the guaranteed day wage is paid when two-thirds or less of the standard task is accomplished. This appeals to beginners and slow workers.

The fact that no high incentive is offered for especially high production reduces the effectiveness of the plan somewhat and, unless each workman's earnings are calculated on a weekly or longer period, is likely to result in spasmodic good work only. The plan is extremely difficult to operate, somewhat costly to administer, and is not satisfactory to workmen since they cannot readily ascertain at any time the amount of their earnings.

**The Group Bonus Plan.**—The basic principle underlying this plan is the payment of a bonus upon the combined effort of a group of workmen. The general operation of the plan is as follows: A group of workmen doing similar or closely related work and numbering sometimes as many as 100, but preferably not over 25, is selected as the unit. The group standard is based upon past experience or upon scientific time studies.

Where the same work is performed by all members of the group, it is unlikely that individual time studies will be made. However, if the work consists of closely related jobs, each task will have a separately set standard and the group standard will be based upon these individual standards. The time wage for each workman in the group is guaranteed and the bonus received by each may be a percentage based on his time wage or an equal share of the bonus earned by the group. The amount of the bonus and the point at which bonus earnings begin vary according to the incentive needed and the savings which can be effected. In some instances, bonus earnings begin before the group task has been attained, and in other cases no bonus is paid until the standard is reached or exceeded. The group bonus is usually calculated upon a weekly or pay period basis.

The group leader or foreman may share on the same basis as the other members of the group or may receive a slightly larger share. In some cases a separate bonus is paid to the leader or foreman based upon the amount of bonus earned by his group.

**Advantages of the Group Bonus Plan.**—The more important advantages of the plan are:

1. **FOSTERS BETTER COOPERATION.** The survival of the fittest typifies the attitude of most workers whose earnings depend entirely upon their individual effort. They are most times

unwilling to stop work to lend a hand to a fellow worker, to answer a question, or give advice or assistance in any way because it is reducing their own productivity and consequently their earnings. In this plan, the group effort is emphasized and each workman fully understands that a portion of his earnings depends upon combined effort of the group and each worker must keep pace with the group.

2. **INSTILLS SELF-DISCIPLINE.** Since the earnings of each member of the group affect all workers they are interested in seeing that there is no soldiering on the job or killing of time in any way. Moreover, each worker assumes responsibility for the methods and facilities used by other members of the group and endeavors in every way he can to see that nothing prevents them from giving their best efforts to the job.

3. **REDUCES SUPERVISION REQUIRED.** In general it can be said that the more accurately the quantity and quality of the work can be measured, the less the supervision is within the group and is self-imposed. The group leader receives instructions from the foreman as to what jobs are to be performed and the order in which they are to be done. He issues instructions to the members of the group and assigns each man his job. In view of the fact that the group leader is a member of the group and participates in the bonus earned by the group, it is his responsibility to see that jobs are correctly assigned, that tools and materials are on hand when needed, and that the work flows along in the proper manner. This work of the group leader relieves the foreman of much of his work and makes it possible to reduce the supervisory force, since one foreman can supervise several group leaders who in turn supervise many workers.

4. **REDUCES AMOUNT OF INSPECTION REQUIRED.** The group bonus plan pays only for finished and accepted work. It is, therefore, to the best interest of each member of the group to exercise care to see that no defective work is allowed to pass to subsequent operations. Thus each worker is a self-constituted inspector for quality and this helps to speed up the work and materially reduce the amount of spoiled work and defective products.

5. **SIMPLIFIES PAYROLL AND COST ACCOUNTING PROCEDURE.** Under the piece rate or other individual incentive wage plans, the earnings of each worker must be separately calculated. Time tickets are made out to show the elapsed time and the number of completed pieces for each job a worker performs. Under the group plan the time ticket merely shows the amount of time spent on the job, which is multiplied by his hourly rate, and to this total is added his bonus percentage to obtain his total wage. This simple calculation requires less time and work than the calculation of each individual time ticket for each job. To secure the labor cost per unit of finished product under the group plan, the total time and bonus earnings for the group is divided by the total number of finished units produced by the group. In other plans, the earnings of each individual must be divided by his total production to secure the cost of each operation. Then the cost of each individual operation is added to secure the cost of one unit of finished product. It is evident that the former method requires less clerical work, fewer records, and is much simpler and quicker in computation.

6. **INCREASES INDIVIDUAL EARNINGS.** The stimulus offered by the bonus, the self-discipline and cooperation which the plan fosters, and the fact that slow, lazy, or inexperienced workers cannot affect the efficiency of the group for any length of time, all tend to cause each worker to put forth his best efforts. He is less likely to allow his individual desires to affect his rate of production or his accuracy because of the fact that his fellow workers are watching and depending upon him to come through with his share. All of these conditions contribute to greater output and consequently greater earnings.

7. **INCREASES PRODUCTION.** The opportunity to earn larger wages naturally brings increases in output. Moreover, the teamwork of the group, the greater care to prevent spoiled work, the more prompt handling of materials, the better use of tools and machinery, and the interest of each member of the group in training new men and in improving methods all contribute to increased production.

8. DECREASES THE COST OF PRODUCTION. Each of the advantages already discussed contributes to the reduction of the cost. It is evident that if the output is increased sufficiently the unit cost will accordingly decrease even though the workers earn more wages. Similarly, if the supervision is reduced, the amount of spoiled work cut down, the facilities more fully utilized and better cared for, further reduction of overhead expenses will result.

There are various other advantages of the group bonus plan such as the added ease of securing good men, the example that is set for others, the speeding up of training and the prevention of work in process piling up at intermediate points. The only objection of merit that is generally advanced to the plan, is that it tends to destroy individual initiative. Where the work is carefully grouped and only similar or related activities are combined and the members of the group possess relatively the same degree of skill or competency, this objection should be of no importance. It must be remembered that workers whose racial or national characteristics do not harmonize cannot be successfully grouped.

**Other Wage Systems.**—The various wage systems discussed are but representative of the many systems in operation. Most of them are similar in principle and many of them possess the same characteristics in operation. Among the systems which cannot here be discussed are those proposed by Diemer, Barth, Merrick, Bedaux, Haynes, Dyer, and several unidentified plans. No one of these wage systems is readily applicable to a specific company. They are designed merely to suggest a basic principle which can be adapted to meet the specific requirements of the particular concern. It is the proper procedure to make the necessary preliminary analysis and then to install a wage system that will protect the workers and the company and will at the same time offer such an incentive that workers will be stimulated to put forth their best efforts at their work and develop a high spirit of cooperation and interest.

**Wage Standardization.**—Individual wage bargaining between employer and employee usually results in the dissatisfac-

tion of both parties. The practice promotes inequality of earnings, discourages the good worker who is not a good bargainer, permits the foreman or supervisor to unjustly discriminate between workers, and makes the cost of labor higher than it should be for the results accomplished.

Jobs that require essentially the same degree of skill, training, and ability on the part of workers, should pay approximately the same wages. Adjustments for long service and other factors may be necessary but they should be superimposed upon a base rate that represents the value of the job. Where products, processes, and work methods are highly standardized, it is usually a costly management practice to fix wage rate by individual bargaining. This sets the price for the man, not the job, and it happens frequently that the better bargainer receives the highest wages, although it may be that he should be receiving the lowest wages. Wage standardization tends to fix wage rates on the basis of job values and to eliminate the element of individual bargaining.

It takes into account all factors which are distinct parts of the job. Those factors are assigned values in order that uniform adjustments may be made in each individual case. The reduction of labor turnover, the overpayment of workers, the savings in time and friction to the company, as well as the effects upon production are among the ways in which costs are affected by wage standardization.

**The Fundamentals of a Wage Standardization Program Are:—**

1. The establishment of a living wage based upon current economic conditions and prevailing wages in the community.
2. The grading of all jobs according to responsibility, skill, ability, and experience required for their performance.
3. The grouping of grades into job classes of increasingly difficult tasks.
4. The establishment of fixed maximum and minimum wage limits for each class and the grades within the class.  
There should be a definite relationship between the

limits set for each class based upon the qualifications required.

5. The provision for regular advancement from grade to grade within the class, and from class to class, based upon efficiency of performance.
6. The provision for employment of new workers at the minimum wages of the grades to which the jobs are assigned.
7. The organization of a committee to administer the wage program. The work of this committee should include:
  - (a) Recommendations for changes in wage policies.
  - (b) Adjustment of wage disputes.
  - (c) Periodic review of wage rates.
  - (d) Adjustments in grades and classes.
  - (e) Revaluation of jobs.
  - (f) Approving wage increases when promotions are made.
  - (g) Preventing the payment of wages above or below those set for the grades.

## CHAPTER 12

### THE BUDGET A TOOL FOR MANAGERIAL CONTROL

The academic controversy as to whether or not the budget is a device for financial, sales or accounting control, or a tool of management has very little meaning. After all, it makes little difference what activity the budget serves, it is still a tool of management. The more important question is, what activities of management can the budget be made to serve. Here again controversy arises. Some writers and business men insist that the budget is suitable for use only in financial control. Others contend that it is a valuable mechanism for the control of marketing while still others argue that it is a managerial tool and is useful in the control of all business activities. This latter belief is shared by the writers. The effective use of the budget, like that of any other tool, requires that it be designed for a specific purpose. The point must be emphasized that the budget is only a tool; its primary value arises from its intelligent use. In this particular, two conditions should be present: first, the budget must be applicable and suitable for use and second, it must be used by those who are skilled in its use. The budget is not a universal tool, neither is it a panacea. These qualities of applicability and suitability are most important in budgeting. There may be many situations and conditions where the theory of budgeting is applicable but due to time or some other factor, a desirable application cannot be made. Discrimination of a high order is necessary to set the bounds for budgeting in a particular concern. Likewise, great energy and skill are needed in training company executives in the value, use, and objectives of budgeting. In order to bring out these points more clearly, it may be desirable to discuss the objectives or purposes of budgeting. An analysis of these purposes may aid in determining the



kind and extent of training which will be needed by company executives who are required to work with and use the budget. Such an analysis may also suggest conditions and circumstances under which a particular kind of budget may be most applicable and suitable to accomplish the desired purpose.

**Aims of the Budget.**—The primary purpose of budgeting is to aid in systematic planning and control of company operations from period to period. Incidental to this purpose, the budget sets up in writing a performance objective for each activity and affords a medium for comparing actual performance against the planned objective. Although broad company plans, policies, and objectives may be established without the aid of a budget, the operation of a budget does aid greatly in determining the need for and in the making of changes and adjustments in plans, policies, and objectives. It has value also in aiding departmental executives in planning their activities and in formulating policies to guide them in their work. Another purpose of the budget is to aid in the control of expenditures and in the determination of financial requirements as well as forecasting the net effects upon the financial structure of varying degrees of activity. In accomplishing these aims the use of the budget is of prime importance in maintaining cooperation and coordination within the company. It tends to unify plans and operations and to focus attention of all concerned on a single objective which it clearly defines. In this way, it aids in increasing the effectiveness of supervision and keeps the executives informed of the company's objective and the degree of accomplishment attained in comparison with that objective.

**Benefits of Budgetary Control.**—The advantages to be gained from a company wide system of budgetary control are not to be regarded as inherent in the scheme itself. They are available only when the dangers and obstacles in budgeting have been overcome. Moreover, not all the possible advantages can be expected to accrue to a single company, nor can the same degree of advantage be expected in all companies. Floyd Rowland reports the results of a survey of a large number of companies in an effort to determine what advantages they are

deriving from budgetary control. Although all companies had not arrived at the same point in the development of their budget practice they reported in general the following advantages:

"The companies replying and acknowledging the use of some phase of budgetary control cited their benefits as follows:

"1. Budgetary control provides a basis for:

- (a) Administrative control.
- (b) Direction of sales efforts.
- (c) Control and planning of production to cover seasonal variations with a minimum disturbance of operations and employment.
- (d) Control of inventories and consequent avoidance of excess inventories.
- (e) Price setting before product goes into production.
- (f) Determination of financial requirements, arranging of bank loans, releasing of capital, and reduction of loans.
- (g) Maintaining a satisfactory cash position.
- (h) Ascertaining which persons in the company are the best managers.
- (i) Control and reduction of expense.
- (j) Control and reduction of costs.

2. Coordinates:

- (a) Finances, sales, and production.
- (b) Plans of the various departments.
- (c) Widespread activities of large companies.

3. Affords a broader perspective of operating policies.

4. Presents a standard practice toward which to strive."<sup>1</sup>

The survey also brought to light some of the mistakes made in preparing for and using budgetary control. These are worth repeating since they are frequently found to be the cause of unsatisfactory budget experience or of complete failure of a budget program to take hold in a company. The more important causes listed are:

- "1. Expected too much.
- 2. Installed too rapidly.

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<sup>1</sup> Floyd H. Rowland, *How to Budget for Profit*, Harper & Bros., N. Y., p. 6.

3. Inadequate supervision and administration.
4. Bad organization.
5. Inadequate accounting system.
6. Inadequate cost system.
7. Inadequate statistics of past operations.
8. Expected results too soon.
9. Failure to obtain cooperation.
10. Failure of president to give active support.
11. Failure to analyze results and ascertain causes of variances.
12. Too many forms—too much details.
13. Attempted to forecast too far in advance.
14. Routine procedure not sufficiently definite.
15. Did not revise the estimates—not sufficiently flexible.
16. Insufficient use of quantity figures.
17. Insufficient market analysis.
18. Insufficient attention to coordinating inventories with production and shipments.”<sup>2</sup>

A study of the points listed above will reveal quickly the causes that underlie them. Although it is not proposed to discuss these points it is desired to indicate the significant fact that many of the causes can be readily traced to the lack of trained personnel to prepare and operate the budget. It was mentioned in a preceding paragraph that since budgetary control is a tool of management, that in order to make it suitable and applicable to the work and in order to obtain effective use of it, a program of education should be initiated for the executives and supervisors who will be concerned with the budget.

**The Essentials of Budgeting.**—Successful operation of a budget is not a matter of luck or chance. It can be accomplished only as a result of careful and thorough consideration of all the factors which may tend to weaken or hamper the use of the budget as a managerial tool. It may be seen from the causes contributing to its failure or partially unsuccessful operation, that most of them are not inherent in the problem of the budget operation but arise from preventable or corrigible

<sup>2</sup> *Ibid.*, p. 7.

reasons. If the purposes of the budget are carefully thought out and within the realm of attainment and if the problems connected with budget installation and operation are solved, there is every reason to believe that the application of the essentials of budgeting will produce a working plan that will operate successfully.

The essential features to be considered before installing a system of budgetary control are:

1. The soundness of the company's organization plan.
2. The adequacy of the accounting classification.
3. The suitability of the general and cost accounting systems in regard to the nature and extent of the data provided.
4. The adequacy and reliability of records of past and present experiences, conditions, and performances.
5. The suitability and effectiveness of the present systems, procedures, and standards.
6. The sympathetic interest of all executives and supervisors toward the aims and purposes of budgetary control.
7. The suitability and accuracy of mechanisms used for forecasting and estimating sales probability and costs of production and distribution.
8. The placing of authority and responsibility on one capable person for the direction and control of budget operations.
9. The determination of the length of the budget period.

Without the consideration of these and many other essentials, it is not likely that budget operations will be wholly successful. It requires an expenditure of time and money to institute a budget program, but unless it is done scientifically and systematically, the expenditure may be lost, friction and discontent develop within the organization, and other unsatisfactory results arise. Establishing a budget system is not a task to be undertaken hastily. Each step in the program must be carefully planned, and frequently a complete program must be developed over a period of time as practice and experience dictates.

**Preparing for Budgetary Operations.**—The thoroughness with which the preliminary preparation for budgeting is carried

out will have much to do with its successful operation. It is not possible to decide that a budget will be a desirable means for accomplishing certain results and then install a system of budgetary procedure. The groundwork must first be laid. Among the many details to be cared for are:

1. ANALYSIS OF AVAILABLE RECORDED DATA TO BE USED IN PREPARING SCHEDULES. The new enterprise cannot proceed very far or very successfully in budgeting until it has passed through a period of experience which has been recorded and which may be used as a basis for predicting the possible performance or accomplishment of the business and its several activities. Similarly, an old business which does not have an adequate and accurate record of its past performance cannot intelligently prepare a sound budget plan. However, a series of estimates may be worked out which can be used until the necessary records are accumulated for the purpose of estimating. Much detailed information relating to output, capacities, and costs must be used in compiling a budget. Unless such information is available, individual guesses must be made, which may sometimes be surprisingly accurate and at other times quite wide of the mark. In any event, it is better to have dependable records as a basis for compiling the schedules, and before they are prepared the data available should be carefully analyzed, examined, and checked.

2. STANDARDS MUST BE ESTABLISHED. Great difficulty arises in making budget schedules unless standards of performance covering individual accomplishment, departmental output, costs, and capacities have been determined. As a rule a shop foreman knows approximately what may be expected of his shop, just as a sales manager can predict with reasonable accuracy what his sales force will accomplish in a given time.

However, such individual estimates are not altogether reliable and since foremen and sales managers as well as supervisors do not become permanent fixtures in a business, it is much safer to have this data in writing. Furthermore, it is difficult to obtain the most satisfactory performance from individuals, or to measure the efficiency of a department or activity

unless standards of accomplishment have been set as a gauge to what should be done. The task of establishing standards is a long and hard one and is never entirely finished. A standard may need revision within a few hours or days after it has been established. Conditions surrounding the performance of work, methods, tools, equipment, and materials may change and the standard is consequently affected and must be changed. Therefore, the most satisfactory budget schedules cannot be made unless carefully established standards of quality, performance, and procedure have been established first.

3. TRAINING OF BUDGET PERSONNEL. The most effective operation of a budget plan requires a highly trained and specialized personnel. It will not operate automatically, nor can its operation be entrusted to the routine clerical or executive staff. It is too much a matter of intricate and detailed study, tabulation, checking, interpretation, analysis, and dissemination of information to permit that. The figures revealed by the budget and the conditions brought to light through its operations are not always favorable to certain departments or to individual executives and might perhaps be suppressed if such individuals or departments were in charge of the budget. The budget staff must be trained in the making of schedules, collecting and tabulating actual performances, making comparative studies of actual and estimated performances, the analysis of performance records, the evaluation of reasons for failure to meet budget expectations, determining the need for revision of estimates, and making available to the executives, officers and supervisors such information as will enable them to sufficiently carry out their work. The budget personnel must not only be trained in the technique of making and operating a budget but must also have a basic understanding of its purpose and use and be in thorough sympathy with the undertaking and vitally interested in its success. Without such a staff the budget cannot function successfully and to full advantage.

4. EDUCATING THE SUPERVISORY AND EXECUTIVE PERSONNEL. Those employees who participate in the preparation, supervision, and operation of the budget program must be

adequately prepared to assume this responsibility. They must be in sympathy with the budget idea, believe in its value, and willing to give it their loyal support. This attitude cannot be secured and retained unless they understand the purpose of the budget, the technique of its operation, and how and where it fits into the scheme of administration of the business. All employees in a supervisory capacity should be given full instructions about the budget, its purpose, its advantages to them, the help it will give in getting a better control of their activities, and how it may be used to obtain better cooperation from their working force and associates. This preliminary task cannot be stressed too much for it may prove to be the turning point in the success of a budget plan. It makes little difference how carefully estimates are prepared or how elaborate the system of records and reports may be if executives are not in sympathy with the plan.

**Budgeting Policies.**—The establishment of a set of clear cut and definite policies relating to the budget plan will avoid much misunderstanding, confusion, and uncertainty and will in many ways facilitate the operation of the budget.

Such policies must be carefully worked out in accordance with the aims and purpose of the budget and be of such nature that they will be applicable and consistent with the general plans and policies of the concern. As a rule these policies should be formulated by the major executives and the head of the budget staff. To give force and effectiveness to the policies, they must be in written form. A typical list of budget policies would include the following subjects:

1. **LENGTH OF THE BUDGET PERIOD.** The duration of the budget period must be determined and adhered to. It is usually expressed in terms of weeks, months, or years.

A typical practice is to budget for one year with a provision for revising the schedules at monthly or quarterly intervals. In some particular types of industry it has been found practicable to budget for a three or six months' period. Many concerns such as railroads, public utilities, and communications companies, such as the American Telephone and Telegraph Com-

pany, prepare estimates or projection sheets covering a period of from five to fifteen years and longer. These, however, deal with certain phases of operation only and are not usually regarded as a budget but are supplementary to the annual or semiannual budget which is the operating guide for each period. Once a budget period has been established, it should be maintained unless imperative reasons arise for its change. Budget records and cost data collected during a fixed period and over several years form an important source of information which is to some extent destroyed if the budget period is changed.

2. EXTENT TO WHICH BUDGETING WILL BE CARRIED. The policy as to the number of individual budgets and the amount of detail to be included in each must be determined. It is altogether too easy to carry budgeting beyond the bounds of necessity or economy by too much enthusiasm.

Similarly, it is oftentimes the case that the budget program fails to accomplish the purpose for which it is intended because too much consideration is given to the cost of its operation. The cost of operating a budget cannot easily be compared with the money savings effected, for not all of its value is directly contained in that source. If conditions warrant, it is possible to develop an individual budget for each major phase of operations or to develop detailed budgets for each subdivision. For example: One concern may use and find the following budgets satisfactory, sales, production, purchasing, and financial. Another concern of a different nature, or sometimes engaged in a similar field, may develop detailed budgets for sales, manufacturing, purchasing expense, materials, labor, power, maintenance and repairs, tools, finance, etc. The good judgment of the executives based upon their experience and the needs of their concern must regulate the type of policy evolved.

3. RESPONSIBILITY FOR PREPARATION OF SCHEDULES. This question plays such an important part in the success of the budgetary program that the policy should receive the most deliberate attention of the executives and be stated so clearly that there remains no possibility for misunderstanding. The placing of responsibility for preparing the proposed schedule



differs widely in practice. Some advance the thought that department heads and supervisors, who will be charged with the responsibility for carrying out the schedules once they are accepted, should prepare them. There is merit in this but it must be borne in mind that many of these individuals are not supplied with adequate records of performance of their departments or divisions. Even when they do receive sufficient data, they are frequently not qualified to interpret or understand it and are easily confused when dealing with figures. Moreover, many of them are not well enough informed concerning the policies and general plans of the business, general business conditions, markets, etc., and therefore, unable to predict with a reasonable degree of accuracy what their department or activity should accomplish.

Many business men advocate the preparation of estimates or schedules by the budget and accounting staffs and then to refer them for approval or acceptance to the operating men. This is in part sound theory, but it fails to recognize the decided advantage and necessity of consulting the operating men in the preparation of the schedules. It is true that the budget staff should have a clear picture of the present and proposed activities and changes in each department and be thoroughly conversant with the major and general policies of the business. Frequently new plans are made and new developments introduced or prepared for introduction, such as new machinery, new products or materials, and new methods which escape the attention of the budget staff.

The failure to give consideration to such matters would affect the schedules which have been prepared. Furthermore, the operating group feels that unless it is consulted in the preparation of schedules, it is not receiving proper consideration and tends to lose interest in the budget.

The best practice of preparing schedules appears to be one which involves the joint effort of the budget staff with the assistance of the cost and general accounting departments and those operating officials and executives charged with budget operation. This provides opportunity for the budget staff to explain the figures to the foremen and supervisors and advise

them of planned changes, business conditions, and policies which may affect their departmental or divisional activity. It also provides an opportunity to procure from them acceptance of the estimated performance and cost of operations assigned to their activities.

The plan of having each supervisor or executive and each salesman prepare his own estimate for his department, section, and territory has advantages in that the individuals definitely commit themselves in writing as to probable operating capacity or efficiency. The detailed work of preparing estimates should be handled by the budget staff, but unquestionably the best results will be obtained if operating executives and supervisors are freely consulted in their preparation and brought to a voluntary acceptance of the schedules as they are prepared rather than being forced to accept them.

4. **FIXING RESPONSIBILITY FOR BUDGET APPROVAL.** In order that the various schedules prepared may be in agreement with each other when finally approved, it is necessary that the responsibility for approval be centralized in one head. A budget for a business would be of little value if each department budgeted its activities without regard for the requirements and demands of other departments. Therefore, the individual, or group, charged with final approval must be certain that each separate schedule is in line with other schedules. For example: the purchasing budget for raw materials must be consistent with the demands of the manufacturing department. Similarly, the plans of the manufacturing department must conform to the plans and anticipations of the marketing department.

The interlocking of the various schedules is sometimes a difficult matter and involves the general policies of the company, which may also bring about friction between department heads. It is evident that the head of a manufacturing department would not care to consent to a production schedule of much less than his plant capacity owing to the increased unit cost involved. However, if the sales department could not see the possibilities of sales of more than say 75% of the plant capacity, it would probably require the curtailment of the production schedule to this figure. Sometimes the sales department

can foresee a growing and lasting demand for the product which will involve the marketing of more merchandise than the plant can produce, and thus the question of plant expansion arises. Similarly, it may be a question of opening up new sales territories which will involve foreign sales, manufacturing of unbranded merchandise, or other measures to bring the sales volume up to the point where manufacturing can be done at a fair unit cost. Therefore, in order to make schedules balance and consistent with demand, the responsibility for budget approval must be fixed. The practice usually followed in business is that the budget staff, in conjunction with the general manager and comptroller have authority for final approval, although in many cases a committee of the major executives, including the president and general manager, assumes this responsibility; the director of the budget being responsible for preparation of schedules and the necessary follow-up work while the budget is in operation. The chief consideration is that responsibility must be definitely fixed in one place and the person or group chosen must be competent to visualize the project in its relation to the business objective.

5. COMPARISON OF RESULTS. The budget staff is usually charged with the receiving of reports of actual operations from the different departments and for comparing actual results with the estimates. This is one of the most important features of the budget plan and must be carried through with care and thoroughness. In this way, much valuable information can be obtained as to conditions in each department, causes for failure to maintain schedules, causes of waste and inefficiency, lack of definite policies, plans, finances, equipment, and personnel. The comparison of actual with preplanned results places in the hands of management a complete picture of operations, enables it at all times to know just what progress is being made, the status of each activity, the unexpected events which disarrange plans, and the efficiency with which operating executives are functioning. Such a comparison is of great assistance in maintaining coordination between departments and in strengthening the control of activities. The information is also of great value in fashioning policies and in making changes in current plans.

6. **REVISING THE ESTIMATES.** Unforeseen changes in business conditions, financial arrangements, and consumer demand frequently necessitate a change in the original budget estimates. It is just as important that these revisions be properly cared for as it is that the original estimates receive the right consideration before approval. The revision of one estimate may involve similar revisions in other estimates. Thus, if it were found necessary to reduce the estimates of sales, it would be necessary to change the schedule of purchasing, manufacturing, and possibly the financial schedules.

To maintain the proper balance between all the estimates requires the same careful study and analysis of all requests for revision, the study of other estimates and plans, and the consideration of ways and means of adjusting schedules as in their original preparation. In the same manner the responsibility for approval of revisions and changes must be centralized. As a rule, it is placed on the individual or group charged with final approval of the original schedules. It is important that revisions be brought to the attention of all interested parties when changes in their schedules are involved. Failure to do this, or lack of promptness in giving the notice, may result in excessive inventories, high costs, or financial difficulties.

7. **DISSEMINATION OF BUDGET INFORMATION.** Plans must be carefully made for the dissemination of budget information to executives and supervisors. Much of its value lies in the fact that it is a convenient means of keeping the various operating men in immediate and close touch with the activities of their departments in relation to specific plans and established standard performance.

In the policy formulated for the diffusion of information such matters as amount of information to be given, method of preparing it, extent of detail, and to whom it shall be given must be considered. Also the use which is to be made of this information, whether or not it is to be considered confidential, and similar questions, must be answered. Many companies do not believe in the policy of providing detailed and confidential information for junior executives and supervisors, while other concerns hold that these men are responsible for certain accom-

plishments and such information that can be given at a reasonable cost will help them to discharge their full responsibility. Many concerns provide their supervisors and executives with certain data, so arranged and presented that it is not wholly intelligible to them. The fact is frequently overlooked that operating men are not as a rule capable of interpreting and understanding complex statistical tabulations and require information presented in terms that are simple and easily understandable. It is an important function of the budget staff to assist operating executives in the interpretation of the data supplied and to point out wherever possible causes responsible for variations from schedules.

**Organization for Budgetary Control.**—The increasing importance of budgeting in business has brought about the almost universal practice of centralization of the budgeting function. There is little consistency, however, in finding a place in the organization structure for this activity. Practice varies widely and perhaps should not be standardized. Certainly, the size and general organization plan of the company in addition to many other limiting factors should be considered before placing it in the structure. In a large radio broadcasting company, the budget division is organized as a part of the treasurer's department; in an electrical goods manufacturing concern, it is placed under the direct control of the president, while in a somewhat similar type of manufacturing concern, it is organized under the control of the general manager on a level with other operating departments.

In other cases, budgeting is a part of the comptroller's department or is organized with the work of the company secretary. Its place in the organization structure is of little consequence, provided it can be most effectively directed, controlled and made to coordinate all other company activities.

Much of the preliminary work in the preparation of the budget as well as the compilation of actual performance records against which estimates will be compared, will be performed in the comptroller's department. Much of the statistical work concerned with forecasting and revision of estimates may be

performed by the budget division even in those concerns where there is a statistical division in the comptroller's department. From an analysis of concerns, it has been found that the budget function operates most effectively under the jurisdiction of the comptroller and as a division of his department.

**Duties of the Budget Division.**—The conduct of a well-rounded budget program involves a varied list of duties and responsibilities. The place of the budget division in the organization, the extent to which budgeting is practiced, and the manner in which the standards and records functions are organized, will bear directly upon the particular duties assigned to the budget division. Included among those duties for which this division will usually be responsible are:

1. To organize and operate the budget division.
2. To design printed forms and develop all budget procedures.
3. To prepare and maintain the budget manual.
4. To prepare budget estimates in cooperation with those executives concerned.
5. To offer constructive criticism of all estimates when necessary.
6. To present estimates and summaries of all activities to the budget committee.
7. To correlate and coordinate all estimates.
8. To provide the budget committee with such comparisons to previous estimates and performances as may be necessary.
9. To distribute the approved estimates and records of actual performances to all concerned.
10. To inform the committee of all necessary budget revisions.
11. To take steps to eliminate possible future errors.
12. To cooperate with all persons having budget responsibility.
13. To submit the budget to the proper authority.

The work of the budget division places it in a position to render an unusual range of cooperative service to all activities of the

business. Much of the success of the budget program depends upon the efficiency with which this division carries out its responsibilities. If it takes the position of a vicious watchdog, and fails to see reason for variations from estimates or necessity for revisions and changes, or if it fails to work smoothly and effectively with those engaged in executing the budget program, the results will not be satisfactory. The suggested causes of dissatisfaction with, or of failure of budgeting listed on page 202 should be constantly kept in mind, and every possible effort made to keep them from appearing.

**Business Forecasting.**—Looking ahead in an effort to determine the future short term course of business as a basis for planning the affairs of his company has come to be an important activity of the business executive. The ramifications and complex interdependence of business makes it impossible for any company to operate most efficiently without planning in advance. This planning must be based upon expected business conditions. Forecasting is an effort to scientifically prognosticate the future trend of business in general. There are a wide range of factors which influence the course of our business economy and each of them must be studied singly and then studied in relation to the whole. Such factors as international conditions; foreign exchange; trade agreements; national political situations; legislative enactments; general economic conditions; degree of financial and productive activity; volume of payrolls; condition of finished goods inventories in manufacturing plants, wholesale and retail establishments; building construction activity; the production rate in the basic industries; the volume of credit; car loadings; interest rates and many other factors must be examined carefully before the forecast is made.

Frequently, unexpected developments make necessary the revision of the business forecast at varying time intervals. The forecast is only a guess, which has been scientifically made in the light of conditions and expectations but it is not necessarily accurate. However, it is the best basis so far developed upon which business plans are formulated.

The individual company endeavors to interpret the general forecast in terms of the industry of which it is a part and then to use this forecast for the industry as a partial basis for forecasting the volume of business which that company should expect during the period under consideration. However, this forecast does not take into consideration local conditions affecting the company such as competition, finances, etc., and it must be modified accordingly.

**The Company Sales Forecast.**—In some companies the sales forecast figure is the same as the sales estimate or sales budget figure while in others it merely serves as a more definite basis for preparation of the estimated sales or budget figure; (the terms “estimate of sales” and “sales budget figure” are both used because it happens in some cases that the term “budget” is not used until the budget committee has approved the estimate). It seems preferable to regard the company sales forecast as a prediction as to the probable sales volume it should have in the light of the expected volume for the industry. Clearly, this figure will be modified more or less by the nature of the plans of a particular company for the coming period. Such factors as the redesign of the product, development of new sales territories, increased expenditures for advertising and sales promotion, the growth line for the company, changes in company marketing policies, and similar factors must be carefully weighed as to their effects upon potential volume. When this has been done, the anticipated volume of sales should be regarded as the sales estimate. This figure should represent the optimum volume for the period, taking into account the factors above mentioned, the plant capacity, the company’s financial condition, general economic trends, and other considerations.

The final volume figure should be expressed in terms of units of products first, and then perhaps depending upon requirements, it should be divided by lines of product, territories, periods, and other classifications as well as by money values. The unit figure affords the basis for the planning of the production, materials, and other manufacturing estimates while the money figure provides the basis for estimating income, and



profit and loss for the period. It also aids greatly in the preparation of the financial budget.

**Preparing the Sales Estimate.**—The final estimate of sales shows expected sales by lines of product, by volume and value, and by periods, usually months. In the preparation of the estimate the branch managers and sometimes the individual salesmen in the territories are consulted and required to prepare estimates which are consolidated by the branch manager, the district manager, or by the home sales office. One large steel fabricating plant prepares all sales estimates in the home office and merely sends to each branch its quota figure for the forthcoming budget period. It is generally felt that the estimates may be more accurate and the sales force more interested in their attainment if they are consulted in the preparation of the estimates for their territories or branches. Estimates prepared by individual salesmen should be reviewed by their branch manager and estimates prepared by the branch manager should be reviewed by the home office before inclusion in the final estimate.

It is the practice in some companies to require salesmen and branch managers to submit estimates of selling expenses at the same time as they submit estimates of sales volume. In other concerns, selling expense estimates are based upon previously established ratios of expense to dollar volume. Usually the sales expense estimates are separately prepared although this does not always hold true.

**Production Budget.**—A balanced production program tends to increase operating efficiency, reduce capital investment in raw materials, tools, etc., facilitate selling and customer service, stabilize productive activity, promote fuller utilization of plant and equipment, and provide many other equally desirable advantages.

The development of the production budget is one step in this direction. This budget indicates the volume of each product required for a given period, such as a month, to meet inventory and sales requirements and at the same time provides the basis for the materials and other manufacturing budget estimates.

The production budget aids in production planning, scheduling the output for each activity, and controlling all activities essential to manufacturing.

**Materials Budget.**—The materials used in manufacturing are classified as productive and service, the former are included in the materials budget while the latter form an integral part of the manufacturing expense budget. Determination of the quantity of raw materials required to meet the production budget for finished stock is based upon engineering specifications and the budgeted volume of production. Unit quantities of raw materials needed for single products are specified by the engineering department and once the finished product requirements are known, it is a mathematical problem to determine correct quantities of these materials that will be required for the production program. As soon as quantities of production materials are determined, the purchasing department can estimate their cost with a high degree of accuracy. In this manner it is possible to prepare a materials budget which will show quantities, value, and rate of consumption of materials required.

These data are valuable in planning the financial program for working capital, and they aid in planning the purchases and storeskeeping work. The materials budget may be constructed on a monthly requirements basis for the budget period or it may be set up on a quarterly or total period requirements basis. Although actual purchases usually await purchase requisitions from stock, it may be desirable in the light of requirements to place supply contracts or to make other commitments when prices and terms are favorable. The careful planning for materials needed facilitates production planning and control and tends to coordinate purchasing, finance, engineering, stores, and manufacturing activities.

**Purchase Budget.**—There should be a clear distinction drawn between the purchase and the materials budget. While it is true that in some cases materials can be purchased directly from the information contained on the materials budget, there are many factors which make it inadvisable to use this procedure. The purchase budget is a compilation of all purchase require-

ments taken from all other budgets, and includes productive and service materials, machinery and equipment, office supplies and stationery.

**Factors Influencing the Need for a Separate Purchase Budget.—**

1. Monthly materials requirements for production may not represent economically-sized buying lots.
2. Extremely favorable prices may be secured through long-term contracts, with or without provision for guarantee against price decline.
3. Some materials may have intrinsic properties which make it desirable to secure a season's supply when it is available.
4. There may be a lag of several months caused by a long-time production process.
5. Materials may vary in relative importance.
6. Materials may be available seasonally while production is fairly regular.<sup>3</sup>

The cost of operating the purchasing department, as such, is included in the factory administrative budget.

**The Labor Budget.**—The labor required for manufacturing operations is divided into two major classifications: (1) productive labor and (2) service labor. The forecast of the former is known as the labor estimate and is the basis of the direct labor budget, while the forecast of the latter is included in the manufacturing expense budget.

The estimate of direct labor needed for the probable required production is based upon (a) the volume of products as stated in the sales estimate; (b) the analysis of operations and processes; (c) the standard times necessary for each operation, which has been prepared by the time study unit; and (d) the labor records of past performances.

The total direct labor hours necessary to produce the desired volume for the budget period can be determined. This figure then may be analyzed and restated in terms of operations and

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<sup>3</sup> Cost and Production Handbook, The Ronald Press Co., N. Y., p. 115.

work. It may be further refined and stated as labor hours by types of skilled and other workers. The labor hours may be then converted into number of workers required by types of skill and by applying the wage rates to the total hours of each type, it is possible to arrive at the cost of direct labor for the estimated production. From these figures, the personnel department will be in a position to develop the labor budget showing the labor requirements of each department by skills or trades for the budget period. Knowing the number of products required each month, it is an easy matter to calculate the personnel necessary for each such period.

The estimated cost of labor by months or other time units as shown on the estimate provides the basis for calculating the financial needs for working capital to finance payrolls and is of great value to the personnel department in planning its program for recruiting, training, transferring or releasing labor according to needs. In this way, it is possible to improve the degree of labor stability and thus to avoid excessive turnover. Moreover, it is clear that if the labor and production budgets are kept in proper balance, there is an effective means available for control of the number of employees without depending upon departmental foremen or supervisors who may be unwilling to let satisfactory men go even when declining volume warrants it.

*A forecast of labor costs based on planned production is necessary to:*

1. Insure availability of required workers to perform the tasks dictated by the production budget.
2. Give the management an estimate of labor cost in total and thus provide for planning of disbursements and working out a forecasted statement of cost of goods manufactured and sold.

**The Manufacturing Expense Budget.**—Manufacturing expense is defined as all expenditures incurred in the manufacture of the product other than the cost of direct materials and direct labor. (See Chapter 6.)

Thus, the manufacturing expense budget is based on an estimate of all these expenses required to produce the budget

volume of production. This group of expenses constitutes a very important part of the total cost of manufacture and it is desirable that they be controlled in so far as it is possible and practicable.

Not all of these expenses are subject to control by the operating executives; such items as insurance, taxes, depreciation, and rent are usually regarded as fixed expenses although they may fluctuate somewhat and although they are in part subject to a minor degree of control by the operating executives. Other items of manufacturing expenses, such as indirect materials, supplies, tools, and indirect labor are subject to varying degrees of control by the operating executives and it is this group which should receive a major share of attention. There are two plans in common use in preparing the manufacturing expense budget. One is to estimate the cost of these expenses and to budget them by the organization units which incur them rather than the organization unit in whose interest they are incurred. For example, the expenses of maintenance, under this plan, should be included in the maintenance budget, in which is shown the expected maintenance cost for each department and by departments. The other method is to estimate expenses as a part of the operating department's cost in which the services are used.

The method of having the several operating departments prepare estimates of the cost of the services, which will be required during the budget period appears to be most desirable from the viewpoint of the control of these expenses. Departmental efficiency and to some extent the efficiency of the department head is judged upon his ability to accurately estimate his requirements and to live within his allotment. The experiment has been tried many times of establishing relationships between volumes of expenses incurred by each department and the volumes of labor, machine hours, or labor costs of that department. The purpose of this idea is to enable expense estimates to be made quickly. If there is a fixed relationship between the amount of departmental activity and the expenses incurred, it is an easy matter to estimate manufacturing expenses for a department once the volume of activity is known. However,

there is, in most cases, little relationship between volume of production and expenses incurred.

**Purpose of Manufacturing Expense Budget.**—This budget aims to control all indirect expenses and measure the efficiency of departmental activity. If manufacturing expense estimates are prepared in detail and frequent statements showing actual departmental expenditures and estimates are presented to plant executives and supervisors, they can examine the variations and determine their causes. This will aid greatly in controlling the causes for variations and may lead to changing shop practices or methods that will bring about reductions in cost. The opportunities for cost reduction in the field of manufacturing expenses are many and varied but the responsible executives and supervisors cannot grasp many of the opportunities unless they know definitely what their costs should be and what the actual costs are from period to period.

**Compiling the Manufacturing Expense Budget.**—The failure to control manufacturing expense materially affects the control of other cost items and the efficiency of manufacturing. A typical list of expense items to be estimated for the manufacturing expense budget are listed on page 107, Chapter 6. The manufacturing departments in which these expenses will be incurred are listed on page 91, Chapter 6.

From an examination of the manufacturing expense items which comprise the manufacturing expense budget, it can be seen that most of these items of expense are common to all factory departments. The fact that no single individual is responsible for originating or controlling these expenses introduces a most difficult problem in the compilation of a manufacturing expense budget. His knowledge of a specific department or activity is likely to be limited, and he is, therefore, not in a position to make detailed estimates of individual expense items for any department. He is naturally interested to a large extent in the ultimate results and should inspect and approve all expenditures before passing the manufacturing expense estimate to the budget committee for its approval.

The form shown in Figure 18 is a convenient means of preparing the shop budget. The plan of showing the estimate for each item according to the department in which the expenditure will be made, makes it possible to secure (by a cross addition of the sheet), the total estimate for each item. The footing of each column will show the total manufacturing expense estimate for each department, while a cross addition of the departments' totals will show the total manufacturing expense estimate of all departments. In the preparation of the manufacturing expense budget for the ensuing year, all conditions which will arise are not known, nor can they be anticipated. It is evident that provision for revision of various estimates must be made as occasion may demand.

**Operation of the Manufacturing Expense Budget.**—The departmental foremen and supervisors must be kept currently informed by reports and statements of actual performance in relation to the estimates. It is only through watchful alertness on their part, that variations can be noted, causes discovered, and new or changed practices and rules developed to prevent reoccurrence of those conditions which cause variations. Although it is possible that there will be substantial variations between actual and estimated departmental expenses in a given month, this in itself is not so significant. It is the ultimate objective to bring the years' actual operating expenses below the budget estimates. However, this result cannot be accomplished unless specific attention is given to the causes of the monthly variations. They are likely to cause wider fluctuations in subsequent months if not corrected or eliminated immediately after their presence is discovered.

Careful study must be given to the question of the nature, extent, and frequency of the reports and statements to be supplied to the various executives. Generalizations on this question would be meaningless; each concern must establish its own policy and practice in this matter.

**Suggested Performance Reports.**—Figures 18 and 19 are shown as merely suggestive. It will be noted that Figure 19, "Monthly Comparative Statement," which may be submitted

THE SHOP BUDGET								Total
For the fiscal year 19. .								
Ex- pense Acct. No.	NAME	Dept. 1000	Dept. 1001	Dept. 1002	Dept. 1003	Dept. 1004	Dept. 1005	
1	Executives							
2	Supervision							
3	Technical Assistants							
4	Inspection							
5	Clerks							
6	Steno's and Typists							
7	Timekeepers and Checkers							
8	Storekeepers and Assist.							
9	Truck drivers and Chauffeurs							
10	Watchmen and Gatemen							
11	Elevator Operators							
12	Janitors and Sweepers							
13	Laborers							
14	Oiling and Cleaning Mach's.							
15	Machine Set-up.							
16	Training Expense							
17	Idle Time (No Power)							
18	Idle Time (Mach. Breakdown)							
19	Idle Time (Waiting for Work)							
20	Taking Inventories							
21	Vacation							
22	Sickness							
23	Military Service							
24	Maint. of Boiler							
25	Maint. of Machinery							
26	Maint. of Hydraulic Eq.							
27	Maint. of Motors and Control- lers							
28	Maint. of Generators							
29	Maint. of Light Eq.							
30	Maint. of Power Lines							
31	Maint. of Pipe Lines							
32	Maint. of Pumps							
33	Maint. of Transmit Eq.							
34	Maint. of Matl. Hnd. Eq.							
35	Maint. of Storeroom Eq.							
36	Maint. of Dies							
37	Maint. of Jigs and Fixtures							
38	Maint. of Gauges							
39	Maint. of Tools							
Total	Carried Forward							

Figure 18. Shop Budget





to foremen or others of similar rank to indicate comparison of actual and estimated performance for the month just ended, shows only the estimated and actual performance and the variations expressed in dollars. A fourth column may be added to show the cumulative variations in dollars or percentages.

In one budget plan, this form is not entirely filled in. Only actual and estimated figures with amounts of variations are shown for items which have varied excessively during the month. In the column headed Increase or Decrease, the amount is noted in red or black ink, depending upon the nature of the variation.

The reasons advanced for using this plan are that the foremen will be interested only in items which have varied excessively during the month, and that clerical labor, time, and cost are saved by furnishing only these items to him. Regardless of what information is given to the foremen, it must always be supplemented by comments and explanatory notes from the budget unit, much can be done in making the information supplied to the foreman of value by interpreting, wherever possible, the meaning of the figures. Likewise, the foreman should be required to explain certain details shown by the records such as drawing an excess of supplies, or working overtime.

Figure 20, "Monthly Comparison of Budget and Actual Departmental Performance," for the use of the manufacturing executives, is also intended to be suggestive only. The form is a convenient method of presenting to the executive the comparison of estimated and actual performance by departments, and also by items of expense. Columns to provide for cumulative figures may be added if desired. This form enables the executive to pick out very quickly the items which have varied excessively during the month and to determine at once in what department or departments the variations occurred.

He is then in a position to call on the cost accountant or department head for an explanation of the fluctuations. In case the clerical labor of preparing this form is too great, it may be modified by grouping the expense items under major headings. For example: Where numerous items of machine and equipment maintenance expense are shown, they could all be grouped



under one head known as maintenance of machinery and equipment and still be shown by departments on the form. It is simple enough to provide forms for presenting the information required to interested parties. The problem is to determine what information should be given, and the most usable form in which to present it, and whether the cost of supplying the information is justified by the use which will be made of it.

**Plant and Equipment Budget.**<sup>4</sup>—Conditions of unbalanced production and changing sales emphasize a necessity for closer control of plant additions. It is probably true that an accounting department renders no greater service to management than when it points out pitfalls that lie in the path of contemplated expansion. Many managers point with pride to perfection of their company's equipment and keen fitness of the plant; cold analysis of costs at varying volumes, required sales volumes to utilize the plant, and a comparison of conditions before and after expansion are needed to test profitability of extension of plant facilities. A policy of budgeting all plant expansion items aids in controlling such expenditures.

Plant and equipment of a company constitute its producing capacity. The term "plant" is often used broadly to refer to buildings and all more or less stationary equipment, while the term "equipment" includes items of movable or portable physical property used in production. From an accounting standpoint these items include all physical production asset costs incurred to buy manufacturing facilities of a life longer than one year.

Expenditures for plant and equipment items can be classified according to reasons for expenditure as follows:

1. *Replacements*

- (a) Normal—due to usual operating causes.
- (b) Abnormal—due to accidents, obsolescence, or inadequacy.

2. *Expansion, due to*

- (a) Increased sales demand in regular product.
- (b) Addition of new and allied lines.

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<sup>4</sup> Cost and Production Handbook, pp. 130-131.

3. To remove or correct certain "bottle neck" conditions in the production setup.

In budgeting these items as a class, the first type of expenditure recurs each year, while those of the second and third classes may or may not be made when a need is discovered. Either of the latter classes is likely to result in actual added output and most accounting departments are lax in their ability to show management the cost consequences and added market demands imposed by such a policy of expansion.

**Nature of Plant and Equipment Budget.**—Since items included in this budget are connected with machinery and plant, it is obvious that adequate records of past expenditures of all classes must be supplemented with study by the plant engineering department. Functions of such a department, especially as they relate to budgeting, are:

1. Constant study of improved methods, new machines, and factory layout, and presentation of proposals for such betterments as seen feasible.
2. Preparation of periodical plant and equipment programs and presentation of such programs to production executives, showing costs and probable savings to be realized.
3. Development and supervision of a proper plan of maintenance and repairs and presentation of it to operating executives.
4. Carrying on a tactful educational program in connection with proper use and care of equipment and trying constantly to cooperate with operators so that cost cutting changes will become fully effective.

The head of the plant engineering department is a key-man in developing the whole plant and equipment budget. Such a budget would need review and, in some cases, revision, in light of other data presented to the budget committee through sales forecasts. Aside from items of expenditure involved in replacing or adding to present plant and equipment, the budget may also include repairs and depreciation, thus grouping all factors relating to plant and equipment in one place.

**The Research Budget.**—Although research is usually considered an expense item and handled as a part of the engineering expense budget, some concerns treat research costs as a separate item and develop a budget for this activity. In such cases it is likely to be the policy to capitalize the cost of research in the form of patents on new inventions. The usual practice for controlling the expenses connected with research were outlined in the chapter dealing with that subject. A research budget should show the estimated cost of labor and materials necessary for research work during the budget period. This estimate would enable the comparison of the actual amounts spent by projects or in total with the estimates and also with the capitalized results of the work.

**The Factory Administrative Budget.**—Those executive, administrative, and service expenses incurred in the management of manufacturing comprise the factory administrative budget. Cost accounting, employment, purchasing, engineering, factory management, time study and rate supervision, production control, and similar expense services are among those variable and semi-variable expenses which compose the group. The executives and supervisors in charge of these various factory administrative activities compile the expense estimates for their respective divisions or departments and turn them over to the director of the budget or the person responsible for budget compilation.

To some extent the volume of expenses in these divisions varies in sympathy with changes in the volume of production. However, there is a minimum expense for each of them below which no change occurs notwithstanding severe reductions in volume of output. This minimum represents the nucleus of the activity, perhaps only the executive or supervisor and one or more clerical workers but if there is any productivity, this nucleus is necessary to maintain the service essential for production. In some concerns an effort has been made to relate the labor cost of these factory administrative divisions to the cost of productive labor but this can be done only with certain types of administrative effort and in certain types of business.

Rent, insurance, heat, light, supplies and depreciation of furniture, and appliances and equipment are among the more or less constant items of expense incurred by these activities which are subject to a relatively minor degree of control by the departmental executives against whose departments they are charged. A much greater degree of control can be exercised over the variable expenses and on these major attention should be concentrated. Careful selection and training of workers and supervisors, proper organization and planning of work, simple and effective systems and procedures, standardization of method, and facilities and the application of other similar managerial principles and practices, will greatly aid in keeping these expenses within reasonable limits.

Regular statements of actual performance costs, compared with estimates and direction of attention to significant variations lay the groundwork for the application of these principles and practices, to introduce new controls and tighten existing ones.

**The General Administrative Expense Budget.**—This budget is, in general, very similar in its preparation to that of the factory administrative expense budget and serves the same purposes. To some extent it affords a basis of control of these expenses but since most of them are incurred under the watchful eye of a senior executive there should be less reason for stressing this budget for this purpose.

**The Financial Budget.**—After all expense and income budgets have been prepared, it is then possible to prepare the financial budget. This estimate is a composite reflection of all other budgets since it shows in dollars, the estimated income and expenses of the business for the budget period. To make it a more valuable instrument for financial control, the estimates are made up by months or other short periods. This arrangement of the estimate greatly facilitates its study by the administration and aids in arriving at a schedule of working capital needs.

Through the information obtained from all budgets, it is desirable to prepare an estimated financial statement for the

budget period so as to forecast the results from operations for that period. If profits are deemed lower than desired or warranted on the basis of volume of activity an analysis is made to determine where estimated expenses are excessive or where they can be reduced. Similarly each source of income is examined and revisions of estimates may be necessary in the light of the figures shown on the estimated profit and loss statement. After all figures have been carefully examined and checked, the estimated balance sheet and estimated profit and loss statement should be submitted to the president.

**Summary.**—A carefully selected and properly trained corps of executives and supervisors, fully aware of the company's immediate and long-term objectives and currently informed as to progress, should result in alert, competent, and efficient direction and control of the business.

The budget program aids in setting forth and bringing understanding of the immediate and long-term company objectives and at the same time it sets up standards against which current accomplishment may be measured. Management should keep in mind constantly that control may be exercised in part through the budget rather than by the budget. Thus, this instrumentality of control remains flexible, applicable, and suitable for the purpose it is to serve. It is evident to all that the budget is an inanimate and inorganic instrument, capable of being moulded to suit management's needs but that it cannot call attention to maladjustments nor can it order or carry out their correction. This is management's job, but it is simplified and more efficient when the budget is used as one of the tools in bringing such maladjustments to light and forecasting coming events.



## CHAPTER 13.

### MANAGERIAL SELECTION OF A COST SYSTEM

Cost and Cost Reduction are problems of vital interest to business men all over the country. During recent years business men have watched the price of raw materials and labor steadily advance from month to month and have been forced to increase the selling prices of their products in order to obtain a reasonable profit. There has been a great deal written and said about the problem of cost determination and the establishment of various types of cost systems, but little has been said regarding cost analysis with the object of reducing the costs of operations or the cost of the product. The cost accountant seems to be interested mainly in the accounting phases and leaves the analysis to management. This is not sufficient, however, and the accountant should prepare his reports so that an analysis can be made and should suggest ways and means for reducing costs. The cost accountant should realize that cost accounting and cost reduction are parallel activities and must be treated as such. However, many manufacturing concerns have created two activities: one, assembling and computing of cost data, and the other, analysis and cost reduction.

The main point is that one fails to appreciate the full advantages derived from analyzing cost data and utilizing the results for the purposes of reducing costs, which is the vital phase of all cost work.

As a general rule, cost data is usually thirty or more days old. Such information is of little value in controlling costs. It is true that comparisons of such costs will portray trends, if they are accurate. It is desirable to establish standard costs as a means of control and as a means of measuring the so-called actual costs.

By comparing the so-called actual cost for each phase of operation with the predetermined standard, a basis is provided for a prompt disclosure of variations from the standard, and through a process of analysis the cause or causes for the fluctuations may be determined readily and corrected before it is too late.

Where the cost accountant is primarily interested in cost accounting and cost procedure, it is advisable to establish a separate unit, or department, for handling the work connected with cost reduction. This unit should be a staff activity reporting to the general manager, vested with the authority and the responsibility of examining and analyzing all costs so that cost reduction will play an important function in general management.

The entire organization should be cost minded, not only from the standpoint of factory costs but cost of administration and distribution as well. Standards for selling and administrative expenses should be established if managerial control is to be complete.

*Definition.* Cost accounting is the classification, arranging, compiling, recording, and analysis of all expenditures incurred in operating a business in order to determine the cost of any given unit or activity.

Its purpose is to aid in managerial control, measuring efficiency and detecting loss and waste.

**What a Cost System Should Accomplish.**—Profit is the difference between the total cost and selling price. If the cost is unknown then the profit is indefinite, or unknown. It is a fallacy to believe that selling price is established by the manufacturer, when, in reality, the economic law of supply and demand is the master of price. Those who sell their products below cost will, sooner or later, arrive at a sad day of reckoning.

Although the business man cannot control price, he certainly can, and should, control cost, but this can be accomplished only through a proper cost accounting system.

A good cost accounting system should aid management in the following ways:

1. To measure efficiency and economy of operations.
2. To determine profits.
3. To establish standards.
4. To show the cost of individual parts, products, and operations.
5. To detect loss and waste, in all phases of activity.
6. To provide a sound basis for the operating budget.
7. To keep track and control of inventories.
8. To control scrap and defective work.
9. To control manufacturing sales and administrative expenses.
10. To detect inefficiencies in the use of tools and equipment, and show the need for new tools and equipment.
11. To control tools and tool use.
12. To detect and control idleness of the human element and machines.
13. To guide management in the formulation of policies.
14. To act as a basis for managerial planning and control.
15. To determine and control depreciation, inadequacy, and obsolescence.
16. To act as a basis for diffusion of manufacturing, sales, and administrative expenses.
17. To formulate wage and wage incentive plans and measure their efficiency.
18. To determine the necessity for and value of employee training programs.
19. To determine economic lots of production.
20. To provide a basis for cost analysis and cost reduction.
21. To provide a basis for executive reports.

**Development of Cost Accounting.**—The specialization of business, the complexity of manufacturing processes, the wide range of articles produced, the keenness of competition, and the desire to apply better control to industrial efforts were the motivating forces which brought about the introduction of cost

accounting. From the initial stages in which cost figures were kept to show the cost of manufacture, cost accounting has slowly developed into an elaborate procedure for compiling and recording cost information relating to each individual activity of a business. With more accurate and comprehensive data, executives have been able to utilize the information to a greater extent in shaping and controlling the course of the enterprise. While this has not become general, the few progressive industrial leaders who have recognized the possibilities of managerial control through costs have thus been enabled to steer their business more successfully than before.

**Better Adaptation of Cost Accounting to Specialization in Industry.**—In the initial stages of the development of cost accounting and its application in industry, the remark was very frequently heard, "I suppose it's all right, but I cannot apply it to my business." For the most part this statement was not founded on a fact basis, but on a lack of knowledge of the principles of cost accounting and their application to industrial operation. In some instances the variety of products manufactured did constitute a difficult problem for the cost accountant who was not as well versed or as skilled in his field as he is today. This and other real and fancied reasons delayed material progress in the development of cost accounting.

In recent years it has been found that the principles upon which cost accounting is based are so flexible that they can be adapted to any type of specialized business. Frequently it is not possible to cost each operation or process because of complications in manufacturing, but basic costs can be always established by adapting the principles to the individual problem.

**The Problem of Determining the Correct Cost System for a Business.**—Through studying the cost needs of specialized business and adapting cost procedure to these needs, there have been developed about five general types of cost systems, each of which has been found suitable to meet the cost requirements of certain types of business. Executives are faced with the task of determining what type of cost system can be best adapted to their business.

Generally, this question is not considered sufficiently, with the result that the cost system selected does not meet the demands made upon it. Before a system of recording costs for a given business can be selected it is necessary to determine what purposes this information is to serve. For example, if all the management wishes to know is the cost of production, it is not necessary to break down costs by departments, operations, processes, etc., but merely to keep accurate records of total costs. If the management wishes to know only the cost of each job, all that is necessary is to set up a cost system to collect and record the costs of doing a given job. In case management wishes to use the cost data as a basis for formulating internal policies, changing and checking the effectiveness of policies, perfecting the control of operations, personnel, and costs, much more detailed information will be required.

The basic principle is to determine the uses which are to be made of the cost data, who will use them, for what purposes, etc., and then to adapt and install a system which will meet these requirements. As a general rule the production order system is identified with intermittent operations, while the process system is associated with continuous manufacture.

Usually in the attempt to discover which of the more common types of cost systems will serve to best advantage in a particular business, it will be found that perhaps two or more systems are necessary to provide the results desired. For example, two distinct methods of costing may be desirable in an industry producing partly on job order and partly for stock. A company manufacturing electric motors will illustrate this principle.

Part of the work done here is the production of motors for stock in standard sizes and with standard attachments, while a certain quantity of the production is the manufacture of motors to the special order of the purchaser. In this case, the production order system is used in costing the production for stock, while the job order (modified production order) cost system is used in costing the special orders. In the foundry of this same concern a class cost system may be used for costing castings.

## Types of Cost Systems

For purpose of discussion the types of cost systems may be classified under the following general heads:

1. Production Order Cost System.
2. Process Cost System.
3. Average Unit Product Cost.
4. Class Cost System.
5. Standard Cost System.

**Production Order Cost System.**—This system presupposes the planning and scheduling of the output before production is started. Production requirements are balanced with planned sales for a given period. As soon as the production schedule has been formulated, based on the sales requirements, a production order is usually issued covering a specified number of units or product.

This production order forms the basis for issuing work instructions to the various operating divisions of the factory. The raw material is charged out of inventory against the order number which has been assigned to this specific work. The time tickets showing the amount of direct labor are also charged against the production order, while manufacturing expenses are added on a predetermined basis. Thus the total costs of producing this order are accumulated on the cost department's copy of the production order, or the cost sheet attached thereto.

In many industries where a part of the production is based on special orders for customers, or in experimental work, the job cost system may be used.

The job order system is a variation of the production order system, the difference being that when special work is performed for a customer, a job order instead of the customary production order is issued to cover the work. The job order covers all parts to be manufactured as well as those parts to be drawn from finished parts stores, and all special tooling, patterns, etc., made for that particular job. These latter items are included in order that their cost may be charged directly against the job, instead of being capitalized as in the production

order system. This method is followed in order that the total costs of producing and assembling the special job may be applied against that specific job order. As a general rule, the production or job order cost system will be found in those industries manufacturing one or similar classes of product. Generally, when this system is used, each element or unit of product may be identified as it is going through process or as a finished unit. Even in industries of the type where the production or job order cost system forms the basis of costing, it is probable, or at least possible, that certain costs of such processes as dipping, plating, spraying, etc., may be best obtained by a process cost system.

The two outstanding advantages of job order cost accounting are: first, the use of this system provides the management with the cost of specific jobs which serve as a basis for comparison with similar jobs done in the past; second, it serves as a basis for estimating the cost of similar jobs in the future.

**Process Cost System.**—This system is used generally as an adjunct to one or more of the other types of cost systems. In a great many industries the product passes through certain processes in which all units of product are treated similarly, and during which no individual unit may be distinguished from any other unit. In industries such as oil refining, sugar refining, crude rubber manufacturing, and paper manufacturing, the process cost system is used almost entirely, since the units of product are not separated.

In the process system the costs are recorded under three respective headings, materials, labor, and manufacturing expense for each operation in the process or for the process itself. The individual totals of three items are divided by the total number of units (pounds, gallons, or cubic feet) which will give the unit cost of material, labor and expense.

**Average Unit Product Cost.**<sup>1</sup>—Because of climatic and other special conditions, true unit costs cannot be obtained in some industries from any one run or production order. Output is so affected by causes which are beyond control of the person-

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<sup>1</sup> Cost and Production Handbook, p. 965.

nel that wide variations in production costs occur. While this condition applies to a considerable number of industries, it is illustrated best by the case of a pharmaceutical manufacturer.

In order to produce serum it is often necessary to inoculate animals over a period of months. While the same effort and expense is put forth, it so happens that the finished product, or usable serum, is seldom the same. A similar condition exists in the production of certain pills or tablets for medicinal purposes. Climatic conditions cause wide variances in finished product. If unit cost of any one run were accepted, it would not be a fair cost. Therefore a number of runs are used in arriving at an average cost. As a new run is added, an old one is dropped, thereby keeping a current average. Average unit cost method is applicable to any situation where the manufacturing processes are beyond control of management because of natural laws.

**Operation Cost System.**—In some industries the so-called operation cost system is employed. J. L. Dohr, in his book on cost accounting, describes this system as follows: "In those industries where a few basic raw materials are sent through a series of operations for conversion to the finished product, the cost system may be arranged to show the raw materials cost for the various classes of product, while the remaining costs are accumulated by operations. For each operation an account is kept to show the labor cost and the burden applicable. The total cost of the product is determined by adding to the material costs the unit cost of each operation through which the product has been sent." <sup>2</sup>

In most cases it would appear that either the production order or the process cost system could be substituted for the operation cost system.

**Class Cost System.**—The principle of this system is, first, to find the cost according to classes of product. Then, if the unit cost in any class is desired, it is obtained through mathematical computation of the number of products in any class divided into the total cost of manufacturing that class. The

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<sup>2</sup> J. L. Dohr, *Cost Accounting*, The Ronald Press Co., N. Y., 1924, p. 465.



class cost system gives only a fair average cost, but it is considered satisfactory in such instances as foundry work, when the foundry is not on a purely job order production. This system is used also by some paper box and wall paper manufacturing concerns. In the foundry, for example, stock castings for standard parts are made up. These stock castings may weigh from 1 to 50 pounds, and in order to apply the class cost system the castings are classified on a weight basis. For instance, all castings weighing 5 pounds and under are called Class A. Castings weighing from 6 to 25 pounds are Class B, and castings from 26 to 50 pounds are called Class C. From one heat of metal, castings in these various classes may be poured. In order to get the metal cost for each class of casting, the cost of the heat is distributed over the different classes according to the weight of the castings in each class.

The moulding and core-making labor are usually considered direct labor, and the workmen are paid on an hourly or piece rate basis. Apparently, this would make possible the calculation of direct labor and material costs for each size of casting based on weight. However, the cost of such calculations would be excessive. It is, therefore, the custom to issue a standing order and to charge the direct labor of moulding and core-making against the standing order covering a given class of castings. Frequently, the classification of castings is determined not on the weight basis but on the basis of the patterns from which moulds are made.

That is, the intricacy of the pattern determines the difficulty and time required to make the mould and core. In such cases the classes may be based upon the character of the patterns. This method is seldom used since there is such a wide variation in patterns that it is not feasible to classify them accurately.

The pattern department is a separate unit. All patterns turned out are accounted for as additional assets on the books of the company, except, of course, in the job order foundry where each pattern is a special order.

The expense of operating the pattern department is usually prorated to the cost of the various jobs.

In the foundry the indirect expenses of moulding and core-making, such as parting sand, plumbago, steel core rods, etc., are accumulated and charged against the castings poured, usually on a weight basis for each class.

In the paper box manufacturing industry, the class cost system is used also. Classes are determined in this case according to the size of boxes, or the paper stock. In the wall paper manufacturing industry, class costs are obtained in the same general fashion as in the foundry, except that in the former industry the classes are based on the designs, patterns, number of colors used, or the paper stock.

There has been, and is yet, considerable difference of opinion among accountants as to the use and merits of the class cost system. The class cost system is regarded generally as being a most economical method of securing a practical cost of foundry operations.

**"Uniform Cost Systems.<sup>3</sup>—***Definition:* Uniform cost accounting comprises a set of principles and in some cases of accounting methods which, when incorporated in the accounting systems of the individual members in an industry, will result in the obtaining of cost figures by the individual members of the industry which will be on a comparable basis. Uniform cost accounting does not mean the preparation of average or standard cost figures for the industry, nor the inclusion in costs of predetermined or fixed elements of costs."

**"Purpose of Uniform Cost Systems.<sup>4</sup>—**The purpose of uniform cost accounting systems is not to eliminate competition but to give the particular industry a real grasp on its problems. Its advantages are as follows:

1. Provides the "one best way" known to the industry to figure costs (although cost accounting is a progressive science and provision should be made for keeping the uniform methods up to date), thereby eliminating expensive experimentation by the members of the industry, individually and independently.

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<sup>3</sup> Cost and Production Handbook, p. 973.

<sup>4</sup> *Ibid.*, pp. 973-976.

2. Results in a better informed competition within the industry.
3. Enables the industry to place facts before regulatory bodies.
4. Inspires confidence in the public that selling prices are established by producers who have full knowledge of the costs of the articles offered for sale.
5. Tends to make the manufacturer (who otherwise would fail to see the advantages of good cost accounting) convinced of the desirability of adopting the methods which his competitors are using successfully.
6. Reveals lines of individual products which have been marketed on an unprofitable basis.
7. Provides, in addition to the above specific reasons, all of the valuable features of good cost accounting generally, among which are the following:
  - (a) Shows the danger line below which goods cannot be sold at a profit, thus serving as an insurer of profits.
  - (b) Acts as a guide to the value, efficiency and waste of workers, machines, methods, operations, and entire plant.
  - (c) Provides a reliable guide and basis for estimating the cost of prospective business.
  - (d) Furnishes current reports for comparing major cost items with standards which are predetermined and thereby measure operating efficiency.
  - (e) Establishes a standard manual of accounting practice so that if cost clerk, bookkeeper, or accountant leaves, the successor will find a system the operation of which has been fully and completely developed."

**Standard Cost System.**—This system is a comparatively new development in cost accounting. In fact, it is so new that it is still largely in the experimental stage. This is responsible for the wide differences of opinion as to the content, purpose, value, and technique of standard costs. Some accountants regard it as a supplementary system, designed to increase the

effectiveness or broaden the field of use of the usual systems. Many persons, the authors included, are disposed to look upon standard costs as being a complete cost system, as well as a measuring device for management to use as such, or in connection with other systems. Predetermination of what the costs will be is the fundamental idea in this system. It is worked out by a process of establishing standards for each element of cost. The manner in which the standards are set and revised and the basis therefor, differ according to the philosophy of the accountant responsible for the work. Some prefer ideal standards which bear little relationship to expected actual performance; others prefer to fix the standards at what they believe will represent reasonable performance under predicted conditions or to fix the standards at a point which might be considered as normal or average for the company without regard to predicted conditions for the ensuing period. Again, some accountants prefer to charge materials into and out of stores at a standard cost and to charge productive labor against production orders at standard rates. Manufacturing expense is charged at standard rates in this as in other cost systems. Where the standard cost system is used as the major plan of cost accounting, actual costs may be collected on a monthly or other periodic basis for checking and comparing against the standards and to permit accounting adjustments at the end of the period. Where the system is used as a supplementary device and a yardstick for measurement, actual costs are recorded in the usual manner and compared with the standard.

Those who have been most active in sponsoring the adoption of the standard cost system as a complete cost plan claim for it the following advantages:

1. To aid in standardization of products, of methods, and of processes.
2. To focus attention on variations from established standards of production cost and factory expense.
3. To provide a means of analysis of variations by causes.
4. To simplify costing procedure and, thereby, to lower cost of operating cost system.
5. To provide information with greater promptness.

6. To provide a common unit of comparison of labor costs.
7. To set normal plant capacities.
8. To provide a uniform basis of comparison for all cost elements.
9. Determination of the rate and direction of cost trends.
10. More accurate cost, and simple costing procedure, in evaluating investments in inventories.
11. Greater practical benefit to the sales divisions in furnishing more accurate and stable costs, as a basis for establishing selling prices.
12. Provides a basis for the determination of idle equipment or idle capacity expense, which can then be eliminated from current production cost.
13. Provides objectives for all divisions of business.
14. Net profits can be predicted and variations from the predicted results can be analyzed by causes.
15. Assists sales and general executives to more effective control by concentrating on exceptions from standard.
16. Promotes cooperation and coordinates the efforts of all divisions of a business as no other agency has succeeded in doing in the past.<sup>5</sup>

**Installing a Cost System.**—The installation of a cost system requires a broad technical knowledge of accounting, cost accounting, and factory practices, coordinated with a thorough knowledge of the managerial requirements of the particular plant. The first step in the process is a detailed study of the organizational structure in order to determine whether or not the organization itself is sound and based on the fundamental principles which will permit the use of modern cost accounting methods. The study of the organizational structure should reveal ways and means of procuring costs of the various activities so that these costs can be measured in terms of economy and efficiency of departmental operations.

The next step consists of an examination and analysis of the product manufactured, machines, operations, processes, material handling methods, and other physical factors, and the

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<sup>5</sup> Cost and Production Handbook, p. 1119.

personnel. This study should reveal the type, or types, of cost systems which will be most desirable for that particular plant.

Step number three leads to an examination of the various forms or paper work used in the plant for reporting or recording production and all other manufacturing activities. An analysis of this nature will reveal the whole record system and provide the investigator with a basis for correlating the records with the proposed cost accounting system and afford a basis also for simplification and standardization of procedure.

The next step in the procedure is to select the cost system best suited, based on the type of product, unit of production, methods of production, the requirements of management, and which will conform to the general accounting procedure.

The starting point of the installation concerns itself with the taking of physical inventories of raw materials, work in process, and finished stock, and setting them up on the respective records.

A system of material requisitions and time tickets should be inaugurated as a means of collecting the necessary data for cost work. The necessary ledgers should be established, as described in Chapter 30, for the purpose of accumulating the cost data for specific production and shop orders issued to the plant.

A cost procedure manual outlining the entire cost system and giving the details of the procedure to be followed should be compiled. The manual must show the types and frequency of cost reports which will be required by the various executives and foremen.

**Recording of Costs.**—Based on the assumption that the managerial needs for cost information are to be considered first in the assembling of costs, it follows logically that these needs should receive first consideration also in the recording of costs. The reasons for this are that, since management makes use of them, the costs should be recorded so that they will be of greatest use and, further, that any request of management for cost data may be easily and promptly filled. Sometimes, where the desired cost information is buried under a deluge of figures, the time required and the cost of preparing this information are

so excessive, that all or a large part of the value of the information is lost. Cost records should be so prepared that management can use them to effect reductions in the cost of operations and determine the efficiency of the various organization units.

**Cost Reduction.**—An effective system of cost accounting is an invaluable aid in carrying out a program of cost reduction. This means a reduction of the cost of making the product, the cost of all operations, and the cost of operating the various organization units. Cost records and reports should be standardized so that they are comparable from period to period and thus become effective measuring mechanisms for control and cost reduction purposes.

A cost system is a good detective when it is used by a skilled executive, but in the hands of the average person it is usually a burden. The cost figures should be used to detect losses and wastes of all nature throughout the entire organization.

**A Managerial Tool.**—Cost accounting is not a companion science to business management. It is a managerial tool designed to serve a two-fold purpose: first, to assist in the control of manufacturing and selling; second, to give periodic reports to executives which will enable them to check the progress and efficiency of business operations, and formulate the necessary plans and policies covering future operations.

## CHAPTER 14

### REPORTS FOR EXECUTIVES

The work of the business executive is largely a matter of planning, directing, and controlling activity. Intelligent control must be primarily premised upon adequate and accurate information which must be presented in the form of usable reports. The formulation and execution of business policies have their origin in reports. Planned activity is checked through the medium of reports. An accurate record of accomplishment is a measure of performance.

**Problems in Business Control.**—The modern business executive is faced with many complex problems of control, such as:

1. The utilization and conservation of human, financial, and physical resources.
2. The formulation and execution of business policies.
3. The planning of operations, methods, procedures, and systems.
4. The elimination and control of waste.
5. The operation of the business at the minimum cost with maximum efficiency.
6. The maintaining of all elements of business in a state of balance and effective coordination.

It is clear that the size of the business, its complexity, ramifications, and its geographical spread of operation and ownership make the problems of control much more difficult. The opportunities for effective personal contact between the executives charged with control and those engaged in execution are limited, thus good control cannot be maintained by this means. It therefore becomes necessary to devise additional means which will



aid in control and at the same time will bring to the executives that wealth of timely, accurate, and comprehensive information which is so essential in the administration of the enterprise.

The solution of these problems of control involves the close coordination and uniform execution of company plans and policies, and a system of communications (reports and statements) that keep executives fully and accurately informed at all times as to progress and developments. This system of communications must be so built up and operated that it provides a steady flow of usable information to executives and supervisors. Its message bearing wires must extend out to every job and activity of the concern and its central terminus must be in the comptroller's department. The information and data coming into the terminal from centers and sources of activity are examined, classified, arranged, translated, and then relayed to those requiring such information.

However, there is a question which must be answered before going further. Who requires this message service of information or reports? In almost every concern, certain executives receive periodic reports and statements of activities and in many concerns executives are not furnished with sufficient information to enable them to handle their assignments efficiently.

Who requires the service of this communications system? Who should be in contact with the sources and centers of activity and with what centers and sources should each be in contact? There is no standard of practice beyond the individual concern, and in many instances practice within a concern is not standard. The first question can be answered on a reasonable basis by saying that any executive or supervisor who assumes responsibility for the control of an activity should be provided with such tools as will enable him to satisfactorily discharge his responsibility.

For example, a shop foreman, an office supervisor, or a branch sales executive having responsibility for costs, production, or other matters, should receive such data that will give him information regarding comparative performance of his unit, in terms of planned estimates. Many executives do not agree that reports and statements should be furnished to minor

executives and supervisors. They argue that for the most part these subordinates are not qualified to interpret such data, or are not interested in it, and that the cost for its preparation is greater than the value to be derived from its use. There is merit to the argument but it does seem possible to train subordinates to want and to make profitable use of reports pertaining to their work. The trouble is in many cases due to the fact that no efforts have been made to determine what information would be helpful to subordinates and such data as are presented to them frequently are of so little aid that they lose interest in it.

**Determining the Individual's Need for Reports and Statements.**—The job analysis method appears to be most successful in determining who needs reports and precisely what data they need. It also aids in determining what form it should be presented in and how frequently it should be presented. In one large industrial concern this method was employed but in a slightly different manner than is usually used; committees were appointed ranging from the level of a committee of foremen, to the level of a committee of senior executives. Each foreman, supervisor, or other person on this level was required to analyze his own job, and specify what data he thought would aid him in the better performance of his work. He was asked to indicate how frequently he would like this information and in what form. He was also required to give reasons why he needed each item listed. His report was reviewed by the foremen's committee and recommendations were then made to the shop committee which again reviewed each foreman's request and the committee's recommendations. The shop committee made such changes as in their judgment were warranted and sent the report along to the next higher committee where it was given a final review and such reports and statements as were approved by this latter committee were authorized for foremen's use. In a similar fashion, this study included all other levels of executive activity. The records and accounting systems were changed to provide the added information and systems, and procedures were created through which the data could be prepared and transmitted to all persons concerned.

It is worth noting that this concern recognized the necessity for giving individual consideration to each type of executive work. It is seldom good practice to prepare the same information in the same manner for executives on different levels and frequently for those on the same level. The economy of standardization is not to be overlooked, but it should not be overemphasized.

Some executives are capable of using information if it is presented to them in statistical or tabular form or even in technical terminology while others are not. To many, visual presentation is most effective and most easily understood. The training and characteristics of the individual as well as his particular job must be carefully studied in order that the data he requires may be so presented as to make it most usable and useful to him.

**Value of Graphics in Presenting Data.**—A business executive must use every possible means of conserving his time. Although he must keep in close touch with a wide variety of activities and conditions, he cannot afford to devote more of his time to this phase of his work than is essential to an understanding of the work. The introduction of the graphic method of presenting data has been of great value to business men because it conserves their time and also because it aids them in understanding better the information submitted to them. It is possible through the use of graphics to portray business trends and movements more clearly than can be done through the statistical method. Similarly, effective relationships, points of departure, comparisons and variations can be more effectively presented and their significance more readily grasped through the use of graphs. Some people are preponderantly visual minded and experience difficulty in understanding data that are presented in tabular or other statistical form. The majority of major executives are not interested in the details but they are interested in trends or the relationship between actual accomplishment and budgeted or estimated performance. A general manager is not necessarily interested in knowing that the sales of a particular commodity for a given period was \$17,425.32,

but he is interested in knowing approximately the volume of sales and whether actual sales are above or below the forecast. The sales manager and other executives are interested in knowing the volume of sales in exact detail and at the same time may desire for quick reference purposes a graph showing trends in volume by product lines. The major executive who has responsibility for broad planning and coordination must not become entangled in a mass of statistical detail. At the same time it is vital that he be aware at all times of trends and relationships. Thus, through the use of the graphic method, he can be kept currently informed and because it is necessary to have the detailed information before the trends and relationships can be plotted, those requiring the detail may secure it without delay or excessive expense.

A word of caution in the use of graphics may not be amiss. It is easily possible to distort meanings, cause wrong interpretation of trends or conditions, and to imply or picture incorrect or non-existent relationships through the use of poor judgment and lack of skill in the preparation of the graphs or charts. The understanding of the fundamental principles of graphic construction and the mathematical theories underlying their development are necessary to sound procedure in their preparation.

**Principles of Preparing and Presenting Cost Data.**—The principles, set forth below, to guide in the preparation and presentation of operating and cost data for business executives are not intended to cover the methods and systems used in the performance of the work. They are designed to aid in making such data as are presented more useful and more usable. Some executives are oversupplied with data, while others are handicapped by the lack of accurate and timely data. These guiding principles even if fully applied will not altogether eliminate extremes, but they will be of definite value to the executive who recognizes the importance of timely information. The statement of principles is not necessarily complete but it will afford a working basis for the development of other related principles.

"Every cost and operating report should:

1. Be prepared and arranged to meet the specific needs of a particular executive.
2. Cover a period adapted to the needs of the particular executive who is to receive it.
3. Have a degree of permanency depending upon the responsibility of the executive who is to receive it.
4. Present information simply by method best adapted to comprehension and uses of executive who is to receive it.
5. Be prompt, accurate, and prepared and presented with sincerity.
6. Be comparable with preceding reports of same kind.
7. Indicate variations in cost and operating results.
8. Be interpreted to indicate where efforts should be put forth to effect improvement in operation and reduction in costs.
9. Be presented in such a way that responsibility for results indicated therein can be traced immediately and without question."<sup>1</sup>

**Reports for Minor Executives.**—The nature of the work and the responsibility assigned to a minor executive should in large part determine the kind of information he should receive. A minor executive holding an operating position is usually responsible for the leadership and supervision of his group and for the efficiency of operation of his section or shop. While he has but little to say about the major personnel policies that affect workers under his control, he is, nevertheless, directly responsible for their performance and morale. He has a minor voice at least in fixing wage rates and in establishing and maintaining suitable working conditions in the section. If labor turnover in his section is excessive he should know about it officially and what causes are producing it. If the output of his section is to be maintained at a given rate, then he should be kept informed at all times as to the actual rate of production in relation to the preplanned rate; similarly, with the quality of the work turned out and the amount of work spoiled during processes. If he is in the marketing phase of the business, he

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<sup>1</sup> Cost and Production Handbook, p. 25.

needs information at all times as to the quantity, types of products sold, and the territories in which sales are made by salesmen under his supervision. Moreover, he should be informed as to customer complaints, adjustments, and cancellations of orders. A supervisor in the office has about the same need for and requires in general the same kind of operating information as does the foreman or supervisor in the shop. In each case the supervisor or foreman has responsibility for the control of certain elements of cost which vary more or less with the efficiency of unit operations. In order that the minor executive may know at periodic intervals how well actual costs are comparing with standards, he must be provided with detailed information concerning each item of cost over which he exercises control. It is not sufficient to give him cost data in summary form. He cannot use it advantageously unless it is specific and in detail. In those concerns where the long range (annual) outcome of the budget is emphasized more than the monthly or other periodic comparisons, the information given to the minor executive should be so presented that he may not only have adequate bases for comparison but may also see the accumulative relationships between actual and planned performance for that portion of the total period which has passed. As a rule, statistical tabulations and graphs portraying only trends are not useful to minor executives. It is not possible to give specific rules that will guide all in the presentation of reports to minor executives engaged in different types of work, or even in the same types of work in different companies. However, the illustrations below will give an idea of what good practice is in some of the leading concerns.

#### REPORTS—DEPARTMENTAL FOREMEN

##### *Should Supply the Following Reports*

Absenteeism—Daily  
Accidents—Immediately  
Attendance—Daily  
Defective materials and parts—  
Daily  
Idle machines—Daily  
Idle time—Daily

##### *Should be Supplied with the Following Reports*

Budget—Monthly  
Cost of operating department—  
Monthly  
Departmental efficiency—Monthly  
Labor turnover—Weekly  
Orders in process and dates of  
delivery to stores—Daily

Interruptions to production—Immediately	Piece work rates—Daily
Lateness of workers—Daily	Tool costs—Weekly
Machine repairs—causes—Daily	Tools withdrawn from crib—Daily
Man hours (productive and service)—Daily	
Number of workers on day work and piece work—Daily	
Overtime—Daily	
Scrap—Daily	
Sickness—Immediately	
Spoilage—Daily	
Volume of production—Daily	
Variation, causes—Monthly	
Waste—Daily	

**Reports for Departmental Operating Executives.**—In the line and staff pattern of an organization, a departmental or line executive of equal rank usually is in charge of a major activity. Most times this activity will be divided into its logical subordinate units called divisions, each of which in turn may be further subdivided into as many sections as desired to improve the operation and control of the division. The department executive is the center of control for that activity. He seldom contacts the detailed work except through his subordinates. He plans the work, organization, and methods of the department in their broad form and works with his subordinates in reducing these broad plans to specific details of operation and control. The departmental executive concerns himself with policy making for his activity and with the control and internal coordination of the divisions of his department and works to maintain good cooperative relationships with all other activities. The record information he requires should be of such nature as to keep him fully informed as to the work of each of his organization units as well as the total accomplishment of his department in its relationship to budgeted expectations and that of other departments. If the departmental executive is the factory manager he will be interested in data relating to personnel acquisitions; separations and changes; inventories of materials in various stages of processing; orders received and filled; rates and volumes of output by classes of products; costs by a wide

range of classifications; spoilage of work; relationship of actual production to schedules; lost time; and a myriad of similar subjects and conditions.

If he is the sales or personnel director his interests will be equally diversified and the information required by him will be along the lines of performance and results, comparative conditions, and such other data as will enable him to know at all times the degree of success with which his plans, policies, methods, control devices, and coordinating measures are working, and at the same time will provide him with the basic data essential to such revision and change as may be necessary in the light of the reported progress or conditions. The particular forms in which data are given to departmental and operating executives cannot be standardized even within a single company for obvious reasons. The point to make here is that the principles previously suggested for reports should guide in their preparation and presentation.

In addition to a wide variety of operating information which would be furnished periodically to departmental operating executives, they usually receive at least monthly expense summaries showing various expenses incurred by their departments during the period. The departmental expense sheets shown in Figure 21 indicates the practice of the Addressograph-Multigraph Corporation in this matter. It will be noted that the summary shows the expenses and budgeted figures for the month ended, and the cumulative expense and budgeted figures this year to date. Where rigid budgeting is practiced, this cumulative feature is of material advantage to the department head, in so planning his activities for the remainder of the budget year as to keep within his allowance, or if he decides this cannot be accomplished, he is in a position to request additional funds.

#### REPORTS FOR PLANT MANAGER

- All reports from operating foremen
- Percentage of piece work hours to total hours
- Volume of production by classes of products
- Analysis of inventories
- Analysis of manufacturing expense by departments



ADDRESSOGRAPH-MULTIGRAPH CORPORATION GENERAL FACTORY EXPENSE STATEMENT					
MONTH OF		and		MONTHS ENDING	
Sub-Acct. No.		CONTROLLABLE EXPENSE		THIS MONTH	
				Expense	Budget
				YEAR TO DATE	
				Expense	Budget
01	Salaries & Wages-Supervision & Clerical				
05	Salaries & Wages-Shop Clerks				
06	Wages-Truckers				
07	Wages-Laborers				
08	Wages-Oil Separating				
09	Wages-Cleaning Machines & Benches				
10	Wages-Cleaning & Greasing Materials				
11	Wages-Compound, Filter, Label and Inspect				
12	Wages-Folding Paper Boxes				
13	Wages-Enameling and Lacquering				
14	Wages-Plating & Polishing				
15	Wages-Heat Treating & Hardening				
16	Wages-Slitting Materials				
17	Wages-Sorting & Arranging Materials				
18	Wages-Stockkeepers				
19	Wages-Tool Crib Keepers				
20	Wages-Stock Record Keepers				
21	Wages-Filling Supply Orders				
22	Wages-Stock Tracing				
23	Wages-Blue Print Making				
24	Wages-Inspectors				
25	Wages-Set Up Time				
26	Wages-Waiting for Work				
27	Wages-Apprentices				
28	Wages-Checking and Changing Drawings				
30	Wages-Electricians, Carpenters & Millwrights				
31	Wages-Engineers & Firemen				
32	Wages-Janitors, Window Washers & Groundkeepers				
33	Wages-Watchmen				
36	Extra Wages for Overtime				
37	Extra Wages for Equalizing Piece Work Rates				
39	Wages for Time in Care of Medical Dept.				
SUB-TOTAL SALARIES & WAGES					
% of Budget Expended					
35	Suggestion Contests				
43	Correcting Parts due to Factory Errors				
44	Salvaging Parts and Material Returned				
46	Scrap from Production				
49	Rearranging and Moving Expenses				
50	Maint. & Repairs-Bldgs., Sidewalks & Drives				
51	" " -Machinery & Equipment				
52	" " -Furniture & Fixtures				
53	" " -Perm. Tools, Jigs & Fixtures				
54	" " -Power & Steam Plant Equip.				
55	" " -Master Punches & Dies				
56	" " -Lead Type Matrices & Dies				
57	" " -Patterns				
58	" " -Dies including Die Parts				
59	" " -Cutters and Drills				
60	" " -Drawings				
61	" " -Micrometers				
65	Perishable Tools				
66	Departmental Operating Supplies				
69	Materials withdrawn from Stock for Testing				
89	Photos and Blue Prints				
(Continued on next page)					

Figure 21a. General Factory Expense Statement

GENERAL FACTORY EXPENSE STATEMENT (Continued)					
MONTH OF		and		MONTHS ENDING	
Sub-Acct. No.	CONTROLLABLE EXPENSE	THIS MONTH		YEAR TO DATE	
		Expense	Budget	Expense	Budget
70	Janitor Supplies				
71	Groundkeepers Supplies				
72	Staty., Prtg. & Off. Suppl. (incl. A/C S2)				
74	Laundry Service				
75	Coal				
76	Electricity				
77	Natural Gas				
78	Water				
80	Incoming Freight, Express & Drayage				
81	Tabulating Machine Rental				
83	Factory News Publications				
84	Professional Services				
85	Travelling Expense				
86	Telephone & Telegraph Charges				
88	Association Memberships, Dues and Subscriptions				
90	Maintenance of Factory Guarantee				
91	Instruction Books furnished with Machs. & Parts				
93	Miscellaneous				
	TOTAL CONTROLLABLE EXPENSE				
	% of Budget Expended				
NON-CONTROLLABLE EXPENSE					
33	Wages-Vacation, Time Off and Holidays				
40	Wages-Council, Union & Committee Meetings				
41	Changing Parts due to Engineering Changes				
42	Tool Expense due to Engineering Changes				
47	Scrap due to Engineering Changes				
87	Watch Service				
89	Inventory Expense				
95	Taxes				
96	Insurance				
	TOTAL NON-CONTROLLABLE EXPENSE				
	% of Budget Expended				
	TOTAL EXPENSE				
	% of Budget Expended				
Production:    Material    Direct Labor    Indirect Labor    Other Burden    Total Production    Burden Absorbed    Burden Unabsorbed This Month Year to Date No. of Productive Hours..... Dollars of Labor per Productive Hour..... Dollars of Burden per Dollar of Labor..... Dollars of Indirect Labor per Dollar of Burden..... Dollars of Production per Productive Hour..... Dollars of Production per Dollar of Labor.....					

Figure 21b. General Factory Expense Statement (Continued)

Comparative statement of incurred manufacturing expenses  
with budget estimates  
Fire drill report  
Analysis of labor turnover  
Safety report  
Inspection of equipment, condition, estimated probable cost  
of repairs  
Analysis of plant payroll  
Orders received  
Orders filled  
Analysis of materials withdrawn from stores  
Plant personnel separations and additions  
Salvage department reports  
Purchasing department reports  
Personnel department reports  
Inspection reports  
Foundry reports  
Maintenance reports  
Power plant reports  
Engineering department reports  
Production control reports  
Tool room reports  
Plant research reports  
Material handling reports  
Violations reports  
Construction reports

#### REPORTS FOR GENERAL SALES MANAGER

Comparisons of actual sales with budget  
Sales: Volume, class and amount (daily)  
Territorial distribution of sales by classes  
Analysis of sales expense  
Cost of sales  
Unfilled orders by classes of product  
Sales returns and allowances by products  
Territories and salesmen  
Analysis of advertising expense  
Analysis of credits and collections  
Individual salesmen's reports  
Orders received  
Shipments

- Analysis of finished stock inventories
- Commissions to salesmen
- New customers
- Salesmen's efficiency
- Analysis of accounts receivable
- Order cancellations by causes
- Traffic reports
- Claims and adjustments
- Branch office reports
- Warehouse reports
- Analysis of legislation affecting marketing
- Statistical department reports
- Credit department reports
- New products under development
- Advertising department reports

#### Reports for Senior Executives and Company Officers.—

The executives in this group would include the general manager, the vice presidents, the secretary, the treasurer, the president, and possibly the chairman of the board of directors. The particular types of information which would be prepared for the vice presidents would be governed by the work to which they were assigned. In the case of the secretary and the treasurer they would not be concerned to any extent with information concerning operations. The treasurer would need complete data concerning financial transactions, expenses, income, assets, and liabilities. The financial statement, statements of capital expenditures; reports concerning credits and collections; commitments for materials; cash receipts and disbursements; the budget and other information would cover a large part of his requirements. The president and chairman of the board will be interested in much the same information as the treasurer except in less detail and in addition will require a wide variety of general business and economic data.

The general manager as the executive head of the operating organization will require a much wider range of operating data as well as essentially the same financial data as are prepared for the treasurer and president. He will require less details than the sales and factory manager or his other operating assistants, but he will be interested in keeping in close and con-

stant touch with each activity over which he exercises authority and for which he is responsible. The following reports are included in those required by the general manager.

REPORTS REQUIRED BY THE GENERAL MANAGER

- Budget comparisons by departments, products and items
- Composite reports of plant operations
- Financial statement
- Percentage analysis of the financial statement
- Composite reports of marketing operations
- Analysis of capital expenditures
- Analysis of inventories and turnover
- Analysis of labor and turnover
- Analysis of administrative expense
- Analysis of plant activity
- Analysis of indebtedness
- Price fluctuations of key materials
- Market conditions
- Quantities of materials purchased
- Analysis of changes in material costs
- Reports on contracts and commitments
- Engineering reports covering research, development, design, experiments, and operations
- Analysis of credits and collections
- Reports of traffic service
- Reports on economic and general business conditions
- Reports on federal, state, and municipal legislation
- Shipments
- Reports on industrial relations
- Reports on rentals, royalties, licenses, and patents
- Reports on foreign affairs and trade agreements
- Reports on social movements

An examination of the suggested items of information for the general manager will indicate quickly that in his case as well as that of other senior executives and company officers that the data must be so compiled and arranged as to show major trends, comparisons, conditions, and movements. The data must be in summary form; details must be omitted, except when especially requested. Simplicity and clearness of presentation are most

important in this case. The time of executives must always be considered and no information should be submitted that is not useful, or which will consume time without yielding definite benefit. Supporting details and full elaboration of the summaries should be available in all cases.

**Summary.**—Foresight in anticipating record needs aids greatly in improving the quality of the record service. Someone must assume the responsibility for constant study of changing requirements in order to see that basic data are collected which may have future usefulness in the light of possible changes and adjustments in the operation or conduct of company affairs. It is not economical to maintain an all-inclusive system of record making in order that all possibilities of future needs may be anticipated. This is costly and tends to slow down necessary work.

Similarly, it is undesirable to overlook probabilities in order to save money now and expend more later or handicap executive work. Individual effectiveness must be maintained at a high level and the ability of each executive must be utilized as fully as possible. Thus, it is profitable to give much thought and study to their record needs and to create and maintain the record service at such a high level of efficiency that at no time will executive activity be obstructed or interrupted due to the lack of adequate and useful information.

## CHAPTER 15

### CONTROL OF DIRECT MATERIAL COSTS

**Material Control.**—The business purpose in the past for holding large inventories of raw materials was to provide against unfavorable fluctuations in market prices, and prevent interruptions to production, but modern management holds that through a system of efficient purchasing and accurate production planning and control, inventories can be held to a minimum. During the long period of depression manufacturers watched the value of their investments in inventories steadily decline day by day without recourse, which resulted in tremendous losses, particularly to the larger manufacturers.

During periods of rising prices profits are made on inventories acquired prior to the price rise, but conversely so when market prices are falling and inventories had been acquired during the rise. The far-reaching effect of these conditions in the accounting procedure is well worth examining. Under the conventional system of evaluating inventories at market or cost, whichever is lower, profits are greatly inflated in times of rising prices, and losses are also increased in times of declining prices. Another factor which must not be overlooked is that of taxation. As a general rule, taxation rates increase in bad times placing undue burden on the progressive business concern. This in itself is cause enough for management to demand that inventories be held at figures consistent with production requirements, market supply, and the time factors of procurement and delivery.

The necessity for material control is no longer a debatable subject but a sound basis for the control of material cost.

An adequate system of material control embodies the following important factors:

1. Specifications for required materials, issued by the engineering unit.
2. Adequate system of material classification for stores, co-ordinated with the material ledgers.
3. Purchase requisitions, authorized by the planning unit.
4. Purchase orders, issued by the purchasing unit, with copies forwarded to the planning unit, stores ledger unit, and receiving unit.
5. Received materials, carefully checked against the purchase order and purchase requisition; inspection report issued, covering condition and quality; rejected materials returned to vendor; vendor's invoice carefully checked with purchase order and also examined by the accounting unit.
6. All accepted materials placed in appropriate bins in stores-rooms and entered on bin tags and materials control ledgers.
7. All materials withdrawn from stores on properly authorized requisitions, charging the production order, or job, for which the material has been withdrawn. The quantity of material specified on the requisition must be deducted from the bin tags. The requisition should be forwarded to material ledger clerks, who price, extend, and deduct, both quantity and value from the respective accounts in the material ledgers.
8. All unused materials must be returned to the stores on properly authorized credit slips, which are handled in a similar manner as the material requisition.
9. All parts, or assemblies, placed in "work in process" stores by production control unit, with the appropriate type of record card accompanying them.
10. Determination of material requirements for varying volumes of production so as to prevent large capital investments in inventories.
11. Establish and maintain a system of physical, or perpetual inventory.
12. Establish and maintain a system of accounting records and a consistent method of pricing materials.



13. Provide for protection against loss or damage of material in stores.

**Determining Material Requirements.**—The planning unit should maintain an analysis of each of the manufactured products, based on specifications and bills of materials issued by the engineering unit. This analysis will make it possible to determine the quantities of raw materials required for any given volume of production and should result in the establishment of a policy of keeping a maxima, as well as a minima, of each specific item in the stores, based on the production requirements. Thus the capital invested in inventory will be at a minimum and consistent with the proposed production schedule. The policy regarding materials should be somewhat flexible so as to cope with a falling or rising market. Hand-to-mouth buying in a falling market may be necessary; long-term contracts in a rising market may be desirable; but today industry requires a steady, uninterrupted flow of raw materials from the vendor to the vendee.

The planning unit should maintain records of the important raw materials, showing the cycle of time elapsed from the issue of a purchase order until the material is actually received. These records should also reveal the inventory turnover of each of these items of material. The following formula gives the standard turnover rate:

$$T \text{ (turnover)} = \frac{R}{AI} \begin{matrix} \text{(requirements for production)} \\ \text{(average inventory)} \end{matrix}$$

Average monthly inventories can be calculated by utilizing the following equation:

$$AI = \frac{R}{T}$$

A careful study of past inventory turnover, rates, and a knowledge of future production schedules enables management to formulate the materials budget and to control materials costs.

**Factors Influencing Inventories.**—In attempting to control the cost of inventories, management should be cognizant of the many factors which tend to decrease the volume and

value of inventories and at the same time operate to increase the ratio of inventory turnover.

- (a) Standardization of products and materials.
- (b) Simplification of procedure.
- (c) Material specification.
- (d) Adequate and accurate records.
- (e) Scientifically selected and trained personnel.
- (f) Mechanized material handling.
- (g) Planning and scheduling of activities.
- (h) Inventory analysis.

A dependable supply of materials is the foundation for production control but through scientific budgeting of material requirements that supply can be maintained at a point where the investment will be normal and the production uninterrupted. By improving inventory control and eliminating large unnecessary inventories, management can increase profits by effecting economies through the efficient handling and protection of the materials placed in the storesroom.

**Product Analysis.**—An analysis of each product will definitely aid in the control of materials and will be of inestimable value to management in analyzing material costs by revealing the following:

1. The constituents of the product.
2. The class and quality of raw materials required.
3. The quantity of material required for each part.
4. The amount of scrap produced in manufacturing each part.
5. The quantity of materials required for varying volumes of production.
6. The sequence of operations necessary.
7. The machines and equipment required.
8. The tools, jigs, and fixtures required.
9. The patterns, templates, and other appliances required.
10. The type and quantity of labor required.
11. The economic run or lot for each part.

The results of the product analysis should be utilized in the formulation of certain production policies in connection with

buying or manufacturing parts and tools. In many cases it is much less costly to buy certain parts from other concerns than to have them manufactured in the plant. However, many factors must be considered before making the decision, such as:

- (a) Comparative costs
- (b) Time required for delivery
- (c) Dimensional accuracy of the part
- (d) Capacity of the manufacturing facilities
- (e) Volume of production

**Material Requisition.**—A material requisition is an order on the stores to deliver the specific quantity and type of material stated thereon. One writer claims that the use of the material requisition is obsolete and suggests that the modern method should be the use of the bill of materials in place of the requisition. The bill of material was used prior to the World War in many manufacturing plants as a stores order; it may be desirable in certain types of industry, but for general cost purposes the requisition is much more satisfactory.

Materials must be withdrawn from the stores only on properly signed and authorized material requisitions. The requisition bearing the date, production order number, job order number, or expense account number, quantity, and description of materials (see page 78) is forwarded by the storeskeeper (after he has made the necessary entries on his bin tags) to the material ledger clerk. The requisition is priced, using the average or "first-in first-out" method of pricing, and the amount is extended. The quantity and amount are deducted from their respective columns on the material ledger sheet.

**Accumulating Material Costs.**—The material requisition is forwarded by the material control clerk to the cost department where the cost of the material is entered on the cost sheets. Thus, the total cost of material for a given production order is accumulated by the cost department. Unused materials are returned to the storesroom and credits are issued. These credits are added to the material stock card and deducted from the cost department's charge for material. Rejected materials

are scrapped or salvaged, and credits are issued in a similar manner for the scrap or salvage value of the material.

In some instances departmental spoilage accounts are set up. In such cases, materials requisitioned to replace those spoiled in a department are charged to that department's spoilage account, which also receives credit for the scrap value of the spoiled parts. In some cases this method involves considerable clerical work and is not practicable. However, this plan tends to reduce the amount of spoilage, and where feasible, it is considered a good method of increasing the operating efficiency of the department.

#### **Place of the Stores Department in the Organization.—**

Wide difference of opinion exists as to the correct location of the stores department in the organization. Some authorities believe that the stores department should function under the supervision of the purchasing department. Others maintain that the stores department should be a separate unit reporting direct to the factory manager. As a matter of good organization, it is our opinion that the material control clerk should be under the line supervision of the production control department and under the functional control of the cost accountant, and that the stores department proper should be constituted as a separate unit reporting to the production manager. The reason for this viewpoint is that the production department is responsible for supplying the finished product to the sales department, and should therefore exercise control over certain activities intermediate to this end.

**Nature of Fluctuations of Direct Material Costs.—**In the absence of a standard cost system to stabilize the cost of direct materials used on a given production order, or on a particular job, the costs of the materials are likely to vary. Market prices of raw materials change frequently. Long-time contracts at fixed prices assist in preventing wide fluctuations in the cost of materials, but, even in such cases, the contracts usually provide for differentials in price on the basis of open market quotations. The customary methods of charging materials to production, namely, the "first-in first-out" method, or the average price

method, are applied not with the purpose of securing a more uniform price for accounting, but in an attempt to secure the closest approximation to actual costs of direct materials.

Fluctuations in the cost of raw materials may result in either an increase or a decrease in the cost of production. The fluctuations in cost may be due to one or both of two major causes, namely, price fluctuations or conditions within the plant affecting the consumption of raw materials. There is a variety of reasons for changes in direct material costs due to either of the major causes stated above. To facilitate managerial control of the costs of direct materials, it is not only necessary to know when fluctuations occur but also to know the causes for the fluctuation, the extent of the fluctuation, and the detailed reasons therefor. To obtain this information a thorough analysis of the cost of direct materials used on each production order or job becomes necessary.

**Direct Material Costs Analyzed.**—It is always desirable to carefully check the engineering estimates and allowances for materials before proceeding with the analysis. The first step in the analysis is to determine through comparison if there is a variation. The second step is the recognition of the various ways in which differences between present and predetermined, or the previous period costs, may occur. The third step consists of tracing the fluctuations back to the original records to determine the cause for the variations; and the fourth step is the justification of the increased or decreased cost of the materials.

In general there are two major ways in which cost variations may be manifested.

1. Increases in material cost per unit over predetermined or previous period.
2. Decreases in material cost per unit under predetermined or previous period.

The analysis of material costs, which are in excess of predetermined, on a given production order, will likely be due to one or more of the following causes:

1. Market increases in the price of raw materials.
2. Changes in purchasing and production policies.
3. Excess spoilage.
4. Charging of the production order with incorrect quantities, prices, etc., or charging of an order with materials that should have been charged against a different order.
5. Theft of materials.
6. Materials damaged in handling.
7. Changes in design, equipment, processes, etc.
8. Too exact inspection.
9. Incorrect or incomplete specifications.
10. Charging of supplies as direct materials.
11. Failure to issue credit for materials returned to stores.
12. Inefficient production control.

The executive who has made a study of these and other causes should have little difficulty in determining which is responsible for the variation and what remedial measures are necessary.

**Market Increases in the Price of Raw Materials.**—This is one of the easiest causes to determine and would, in most instances, be the first to be checked and eliminated. Increases in material costs will be reflected in changing market prices, increased freight rates, warehouse, storage, or cartage charges. When material costs have increased during a period, the executive analyzing costs usually refers to the material ledgers to make a comparative study of raw material costs. If he finds that prices have increased, then he can satisfy himself that the increase in material costs may be justified. He should of course inquire into the possibility of better purchasing contracts and perhaps investigate the possibility of substitute materials.

**Changes in Purchasing and Production Policies.**—The executive should make a careful study of the purchasing and production policies pertaining to materials, such a study may reveal that indefinite or rigid restrictions are placed on quantities and quality of materials to be purchased; or that the maximum and minimum inventory of each item of raw materials

may not permit the most economical purchasing, and as a result, materials cannot be bought at advantageous prices or on desirable contracts. Variations in material costs as a result of contract or lack of contract purchasing are difficult to expose, except through an analysis of the methods used by the purchasing department.

A purchasing policy may be violated to take advantage of a temporary market situation which will probably be revealed in the material costs along with other situations arising from such conditions as opportunities to buy in excess of manufacturing requirements to obtain price advantages, buying distress material from a bankrupt supplier, abandoning a contract, and buying at market price. Purchasing policies should be changed only after most careful consideration, and only when it is certain that the interest of other activities of the company will not be injured.

**Excess Spoilage of Materials.**—If the causes for increased material costs cannot be traced to market fluctuations, it may be well to examine the spoilage records to see if too much spoilage has caused increased costs of materials. This information will usually be found in the inspection reports, in spoilage, junk, and salvage accounts. Where it is desirable, raw materials are inspected when received in the receiving department. However, in the case of castings, defects may not be discovered until the castings are being machined. Spoilage is one of the most difficult causes to control because so many factors are involved, any one of which may be responsible.

**Important Causes for Spoilage in Production.**—

1. Careless operator.
2. Poor tools and machines.
3. Defective light.
4. Improper working conditions.
5. Lack of specifications.
6. Incorrect machine setup.
7. Oral instead of written instructions.
8. Incompetent operator.

9. Too low or too high speeds of machinery.
10. Poor materials.
11. Standards too high.
12. Poor supervision.
13. Poor wage payment plan.
14. Inadequate storage.

There are several other reasons for excess spoilage, such as too exact inspection, change in design, assemblies, etc.

**Responsibility of Service Departments.**—It must be understood that the engineering department is responsible for the specifications, machinery, tools, and equipment used. If spoilage can be traced to any of these causes, the matter is regulated through that department. If it results from the carelessness of the operator, it is a question either of supervision or training.

Through tracing the reason for the spoilage sometimes much more important conditions are discovered. For example, the effectiveness and value of a training department might in part be measured through this analysis. The extent and character of supervision might be determined. Accuracy of the engineering department's plans of operations and processes, selection of machinery, equipment, etc., can be partly checked in this way. This analysis might lead to a revision of inspection policies, standards, and allowances for spoilage, to the establishment of incentive wage systems to reduce spoilage, or to the application of penalties on piece rates for excess spoilage.

**Classification of Spoilage.**—Spoilage may be divided into two classifications: first, defective products which may, through additional expense, be reclaimed or sold as seconds; second, materials that cannot be reclaimed and are classified as scrap and sold for the scrap value of the materials. In a great many industrial companies a salvage department is established to which all spoiled work is sent, for the purpose of reclamation. In cases where the part cannot be reclaimed it is turned over to the scrap pile.



**Accounting Treatment of Spoilage.**—The question arises as to the allocation of the cost of the spoiled materials. In some cases the cost of the material and the accumulated labor cost up to the point of spoilage are charged against a departmental expense account.

This affords a check on spoilage and calls the foreman's attention to what is going on in his department. The cost of reclaiming a part may be handled by charging production with no more than the regular cost and the balance to the spoilage expense account of the department in which the part was originally spoiled.

In other cases, the spoilage is charged against the production order or job direct, and a record is made against the department. This record serves the same purpose as the charge does in the first illustration. Inasmuch as the cost of spoilage is charged ultimately against the production order in the form of manufacturing expense, the latter is a more direct method of applying it.

**Charging of the Production Order with Incorrect Quantities, Prices, etc.**—Incorrect charging of material is a result of ignorance or carelessness on the part of the foreman or clerical force and should be promptly corrected in either case. Many times, indefinite accounting classifications, failure of the requisitioner to indicate the correct order or expense number, carelessness on the part of the materials ledger or cost clerk, or posting the material requisition to an incorrect order or expense account, will be the cause for fluctuations in material costs.

Although errors of this nature frequently occur in business, there is no excuse for such, and management must impress the supervisors and workers with the necessity for accuracy in all business records.

**Theft of Materials.**—Obviously, when materials charged to production are stolen, the direct materials cost will be increased. It is so much easier to steal materials in process than from the storesroom that, oftentimes, such thefts become a source of great loss to the company.

Careful supervision, better selection of workers, and a more accurate check-up and count of materials will help to overcome this cause for cost variation. Many losses of materials may occur in the storesrooms, but the cost of these losses will not be revealed in analyzing direct material costs. A policy of frequent, unexpected, physical inventory is the best method of eliminating this industrial cancer.

**Materials Damaged in Handling.**—Cost increases due to this cause will probably be revealed in the spoilage account. However, the cause should be traced back to its origin, where, undoubtedly it will be found that the damage to the materials or parts had been caused in the storesroom or by the materials handling unit in transporting the articles from stores to operations. Items of materials dropped on the floor, thrown into bins, or improperly packed into the boxes, may be considerably damaged, but this may not be discovered until the materials are in production.

**Changes in Design, Specification, Equipment, or Process.**—A change made in any of these factors may result in increased material costs. The increases may not show in the cost of the production order going through, at the time the change is made, but they will show in later orders or in future cost periods. Increased material costs due to a change in one of these factors must be further analyzed to determine if the benefits from the change justify the increased material costs.

For example, a change in the material specifications for a product may result in the use of more expensive materials. This will cause an increase in material costs for the same product over different periods. Although analysis will show that a more expensive material is being used, it should be followed through to determine the benefits brought about by the use of the more expensive material. The follow-up analysis should include such questions as these: Does it facilitate production to the point where the additional cost is justified? Does it reduce spoilage to any extent? Can greater output be obtained? Can the sales price be increased? Does it give a competitive

advantage equal to the increased cost? Does it help fix the market position more solidly?

In cases where material costs have increased due to one or more of these causes, it is always desirable to examine other costs and expenses to discover if there has been a compensating decrease to justify the changes made. Frequently changes in type of raw materials or processes will result in diminishing certain service expenses or the amount of direct labor required in productive operations, and naturally, if this is the case, the change is well worth while, providing other conditions remain constant.

**Too Exact Inspection.**—A rigid and exact standard for the product and an inspection policy which requires the absolute may cause increased material costs, due simply to the greater consumption of raw materials brought about by the great amount of rejections.

The quality of the product must not be in any manner jeopardized for the possible chance of making small savings in direct materials, and therefore loose inspection methods or standards must not be tolerated. However, in many cases it is profitable to question the engineering standards advocated for inspection.

It is a typical engineering requirement that all parts must be worked to a high degree of precision. The cost of securing this precision may not be consistent with the value of the part or product and frequently the cost to manufacture is not considered by the engineer, who is likely to think only in terms of accuracy. Examination of the rejected products may sometimes lead to a reduction of the severity or precision of the inspection standards, and thus save materials, reduce inspection costs, and facilitate production. Time study men and inspectors are in favorable positions to detect the rigidity of inspection standards.

**Incorrect or Incomplete Specifications.**—If the specifications accompanying the "work in process" are incorrect, it is obvious that the products manufactured to those specifications will not be satisfactory. However, inasmuch as all engineering

specifications are carefully checked before leaving that department, this cause of spoilage seldom exists, except in those plants where negligence is fostered.

**Supplies Being Charged as Direct Materials.**—This fault may be due to carelessness on the part of the foreman or clerical help who distribute the charges for supplies, or it may be due to a lack of proper classification of expense accounts, thus leaving the burden of determining the distribution of the charge to the foreman or clerk. Carelessness in this respect should be discovered by the cost clerk when the requisitions come to the cost department. Lack of proper expense classifications should be remedied by the cost accountant.

**Failure to Issue Credit for Materials Returned to Stores.**—The policy of issuing credit slips for all materials returned to stores should be strictly enforced in every case. The credit slip is the medium for crediting the material costs of the production order or the expense account; it also acts as the credit medium for the stores bin tags and the material ledger. It is easy to understand how excess materials may be withdrawn from the storesroom for certain production or job orders, when it is realized that some work performed on an automatic screw machine requires five or six bars of steel to be in the machine at the same time. The commercial length of these bars is approximately fifteen feet. They are issued in full length by the storeskeeper. As soon as the production order is completed by the operating unit, all excess materials are returned to stores, frequently without the necessary credit slip. This situation is revealed by an increase in the cost of raw material consumed for the order in question. In some cases the storeskeeper destroys the credit slip for the purpose of building up what he calls a secret reserve. This idea must be brought to light and eradicated by management. It is extremely difficult to determine whether or not the lack of a credit slip is the cause for the increase in material costs, without making a tabulation of the material requisitions covering the particular job or production order, and comparing the quantity of materials drawn with the quantities prescribed by engineering specifications for each

unit of product. An error of this character also has the bad effect of upsetting the accuracy of the stores records. The physical result will be a greater volume of materials in stores than appears on the material ledger sheets which means an inventory discrepancy which cannot be accounted for until those undesirable conditions are disclosed.

**Inefficient Production Control.**—This is an indirect way in which material costs may be increased, and it is not common, although many times through inefficient production control, materials in process and semi-finished stock may be lost for an indefinite time. In such cases new materials may be drawn from stores, and new parts made. The additional material is, of course, charged to the production order, and although the production records disclose the fact that more than the required number of parts were produced, the excess number cannot be located.

The alert cost accountant should have very little difficulty in exposing a situation of this nature and, once exposed, it is the management's responsibility to determine and put into effect the necessary remedial measures.

**Decrease in Direct Material Costs.**—It may seem somewhat unnecessary to consider the examination of conditions which bring about a decrease in the direct material costs of a part or product, as it is usually taken for granted that such conditions are the result of efficiency and therefore a good omen, and no further investigation is necessary; but this is a fallacy and often leads to uncontrolled waste. A thorough analysis and investigation of decreases in costs is just as essential as the examination of increased costs; the mere fact that costs have decreased and are lower than those of the preceding period must not be taken too literally. Furthermore, it must not be assumed that lower market prices or operating economies are responsible for the decrease, and that conditions are, therefore, satisfactory. The possible reasons must be checked and the decrease attributed to the exact cause. Then the analysis must proceed from that point to determine if the decrease is desirable or harmful. The following are a few of the major

reasons why material costs may show a decrease over comparable cost periods or for successive production orders:

1. Decrease in market price of raw materials.
2. Charging production order with incorrect quantities, prices, etc., or not charging the right materials to a given order.
3. Incorrect or incomplete specifications.
4. Overissues of credit for returns to stores.
5. Changes in design, specifications, machinery, equipment, etc.
6. Substitution of materials.

**Necessity for Analyzing Decreases.**—Similar factors have been discussed in connection with the causes of increased direct material costs. It is obvious that the reverse application of these same causes do not necessarily mean savings. Less production, lower standards of quality, additional labor cost, or other increases in manufacturing costs may more than offset the decreases in material costs. It is apparent, in any case, that the causes for decreased material costs should be revealed by a careful analysis. Otherwise, estimates on jobs, quotas for budget purposes, wage increases, etc., may be made on partially incorrect bases. In case the decrease in material cost is not offset by a similar increase in some other cost element, or cannot be traced directly to some improvement or economy in production, it may be fairly assumed that the quality of the product has been lowered, or that greater chances are being taken with quality standards. This may result in an increased number of complaints from customers, accompanied by additional and increased service expenses on the part of the company and later followed by a rapidly diminishing volume of sales.

**Significance of Cost Variations.**—Management is less interested in the fact that the direct material costs have changed than in the discovery of the causes for the changes. The amount involved in a change of direct material costs may be small, but the significance of such a change may indeed be far-reaching in effect. When it is realized that any one of the

causes, so mentioned, may be of sufficient importance to bring about a vital decrease in the volume of sales, drastic reductions of profit or even foment labor troubles, it is easy to understand management's exacting attitude in connection with the analysis and interpretation of cost figures.

## CHAPTER 16

### CONTROL OF DIRECT LABOR COSTS

**Analysis of Direct Labor Costs.**—*Definition:* Direct or productive labor may be defined as that labor which is an integral<sup>1</sup> part of the product. Labor costs are procured by various methods (see Chapter 5) depending on the characteristics of the products, the extent of mechanization, the physical layout of the plant, and the type of work performed. The usual mechanisms required for collecting time expended in operations are the time clock cards and the time tickets (see pages 80 and 178) either through a departmental or centralized system of timekeeping.

**Time Analysis.**—It is impossible to overstress the importance of production control and time study in estimating and controlling direct labor costs. Each individual task and operation must be carefully studied to determine the economic time for their performance, and to set a rate for the operator which will be satisfactory to him and the company. The analysis of the time element of job performance has a direct bearing on the fundamentals of productive labor costs. If inefficient methods of doing the work are tolerated the resulting inefficiencies are directly reflected in increased costs of direct labor. The object of time analysis is, first, conservation of time through the better control of those production factors which are time consuming, and second, the development of improved performance methods in order to secure the most effective usage of available productive time.

The analysis of the time element should follow a definite line of procedure and not only cover the work, but also the working conditions. The person making the analysis should

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<sup>1</sup> Constituting an essential part of a whole necessary to completeness.



constantly bear in mind the effect of each step on the ultimate labor cost of the product. Time analysis consists of the following steps:

1. The thorough analysis of the conditions surrounding the job, the machinery and equipment, the physical layout of the plant, and the methods of material handling, to aid in discovering the most economical and efficient methods of performance.
2. The elimination of the undesirable and inefficient production factors encompassing the job or work, including machines, tools, etc.
3. The segregation of the performance of each job into its elemental motions.
4. The synthetic construction of improved methods and motions for the job, so as to obtain the best possible coordination of activity of performance in the smallest amount of time, for the purpose of determining the economic base time required for doing the operation or operations.
5. The determination of the desirable allowances of time for fatigue and necessary delays.
6. The conversion of the results to a written standard covering the necessary manual motions, their sequence, operations, tools, and equipment, along with the allowable time involved.
7. The establishment of an effective wage rate with appropriate incentive, based on the standard time set and the current wage for the particular type of work performed. This rate is utilized for computing the workers' wages and forms the basis for direct labor costs.
8. The training of the worker to perform the tasks under the prescribed conditions and in the time set for the job.
9. The establishment and maintenance of ideal conditions, tools, equipment, and materials.

Time analysis is an extremely technical study and requires the services of a technically trained person, perfectly familiar with all phases of the technicalities of production. An efficient

production engineer will do a great deal in the matter of reducing direct labor costs.

**Machine Capacity Analysis.**—The time element may be further reduced and simplified by an adequate determination of machine capacities and the time required to perform the various operations. It is true that plant mechanization has been brought about primarily for the purpose of perfecting the product and reducing production costs by increasing volume and reducing labor costs.

**Machine Analysis.**—Machine analysis consists of an examination to determine:

- (a) The desirable type of equipment necessary to turn out the products and the various classes of tools to be used for the particular work.
- (b) The time consumed in setting up each job.
- (c) The time consumed for performance of each operation.
- (d) The number of units which can be produced on each machine in any given length of time.
- (e) The daily plant capacity of completed units, based on the machine capacities for each part or process.

The analysis of machine capacities provides an excellent basis for determining time consumption, and thus offers a foundation for estimating direct labor costs and developing standards. An analysis of this nature enables the production control unit to schedule and route the production, so as to prevent any "bottle necks" or any other such hindrances to economical output. With the time of each operation and process known, adequate flow sheets can be prepared which will act as guides for planning production so that it will conform to the sales requirements. All interruptions to production mean additional costs to the manufacturer.

**Operating Analysis.**—An operating analysis consists of an examination of the various operations and processes required in the manufacture of each of the products. Such an analysis includes the following:

1. The determination of the most economical manner of performing the work, from the standpoint of perfection of the product and efficiency of equipment.
2. The determination of the best type of jigs, fixtures, and other tooling necessary.
3. The determination of the most economical grouping and layout of equipment.
4. The determination of the economical sequence of operations or processes and the flow of work.
5. The determination of the various points at which inspection should take place, and the type of inspection to be performed.
6. The determination of the most economical method of handling the materials and products to and from the machines.
7. The determination of supervision requirements.

Again it is pointed out that all these studies have a very definite bearing on time and cost of labor, and it is recommended that these analyses be used by management in conjunction with and as a check on labor costs.

These analyses, along with a knowledge of production requirements, form a basis for determining the labor budgets and labor policies, which of course are of great value to management in solving its problems of control.

**Labor Costs.**—The personnel unit is responsible for providing the required supply of competent labor to satisfy production requirements. All costs in connection with labor must be classified so that (a) each worker will be paid his correct wage; (b) that the costs of labor will be recorded on the correct production order or expense account; and (c) that the various ledger accounts, when analyzed, will give adequate information as to operating efficiency and accurate costs of labor.

**Analysis of Direct Labor Costs.**—In making an analysis of direct labor costs it is necessary to procure the original time tickets and start by checking back the wage rates with those set by the time study unit or the day rates at which the em-

ployees are working. The next step is to examine time tickets in conjunction with the operations specified on the engineering blue prints or schedule of operations, to determine whether or not these operations or processes have been performed in accordance with the specifications set, and that the work has been accomplished on the machines which have been designated by the production unit.

It is, of course, desirable to have a knowledge of the factors which are responsible, either singly or in conjunction with one or more other factors, for causing fluctuations in productive labor costs. Such knowledge will materially aid the analyst in arriving at a conclusion as to the causes for the variations.

Variations in productive labor costs may be either in the form of increases or decreases, over previous, standard, or estimated costs and may be attributed to the following:

1. Increases in rates and wages.
2. Excess spoilage.
3. Charging the production or job order with an incorrect amount of labor, errors in rates, or extensions of time tickets.
4. Changes in design, equipment, processes, operations, materials, or methods.
5. Poor supervision.
6. Idle time.
7. Poor time studies.
8. Defective equipment, machines, tools, materials, etc.
9. Excess supply of labor.
10. Class or type of labor.
11. Labor turnover.
12. Poor wage payment plan.
13. Poor cost system, inadequate or incorrect records.
14. Labor trouble, strikes, walkouts, sitdowns, etc.
15. Dishonesty among employees and supervisors.
16. Undesirable working conditions.
17. Mixed sexes.
18. Increased working hours and overtime paid.
19. Changing from machine to hand labor or vice versa.

20. Personal work performed for employees and time charged to production orders.
21. Inadequate instructions or specifications.
22. Inefficient timekeeping procedures.

**Factors in Increased Labor Costs.**—Oftentimes, small increases in direct labor costs are ignored. The practical reason for this is based upon the belief that the increase is so small that, even should it be eliminated, the cost of finding and correcting the cause would more than offset the increase. While this attitude is sensible in some cases, the small increase in one period may be the introduction of a condition which will result in large increases during subsequent periods. It may be much less costly to correct a symptomatic cause at its first appearance than at a later date.

The general attitude of the management should be that every increase must justify itself by a saving. Otherwise the small increases in various elements of cost, when accumulated, make a total increase amounting to a large sum. Wherever possible, the savings should be measured in dollars and cents. This cannot always be done, but the effects of the increase should be observable, if not measurable. For instance, wage increases are sometimes given to a worker as an increment for long service in the company. While output may not increase as a result, morale and satisfaction should be better and will probably find expression in lower spoilage or greater loyalty in the intangible things which are so vital in the field of industrial relations. Several important reasons have been set forth for increased direct labor costs. They should be further analyzed so that the possible effects of each of them on the policies, organization, and administration of the business may be observed. With this in mind, a few of the conditions or effects which may arise as the result of any one of these factors being responsible for increased direct labor costs are here suggested.

**Increase in Wages.**—Where the plant is operated by union labor the analysis is much more difficult and usually less effective, since in most cases the wage increases are made only

according to union rules. A few of the more general causes for wage increases are:

1. General economic conditions, which may include increased cost of living, increase in the going rate of wages, shortage of labor, etc.
2. Incentive policies, which may in effect offer a division of savings or profits, straight increases of rates based on higher output, etc.
3. Changing of wage payment plan. This might include a shift from day to piece rates, or a bonus system, or differential rates.
4. Annual increase policy. This is more common among clerical workers than among factory employees, but it sometimes happens that the management arbitrarily authorizes annual wage increases.  
This increase may be for length of service, since it does not discriminate according to the value of the individuals.
5. Overtime.
6. Changing of task standards; resetting of rate standards.
7. Individual dissatisfaction of the workers.
8. Promotion.
9. Relationship or friendship to the supervisor.
10. Increased job hazard.

The last four reasons are more or less applicable to individuals, and are, therefore, of less importance. When the cost of direct labor has increased because of wage increases, an analysis must be made to determine and justify the reasons therefor. In concerns having definite wage policies, the analysis may be quickly and satisfactorily made. Unless scientifically determined task standards and minimum and maximum pay rates have been set for each task, the analysis becomes a problem of great difficulty, and may fail to uncover sound reasons for the wage increases. In such cases, the great value of making an analysis is to bring to light the need for concrete and specific regulations covering wage increases.

**Accounting Treatment of Labor Consumed on Spoiled Work.**—The technique of accounting for the cost of direct

labor consumed on a product which is spoiled during process differs according to the accountant's point of view. Two methods are representative of usual practice. One plan is to charge the direct labor on spoiled products to the department in which the spoilage occurs. Sometimes a standing expense order for each class of spoilage is set up for each department to which the cost of this labor is charged. Some accountants argue that since this labor eventually finds its way into the total cost of production, it should, therefore, be charged direct to the production or job order. The practice of charging the department with the cost of labor on defective products helps to place the responsibility for spoilage. This practice also aids greatly in analyzing the causes and eliminating the reasons for spoilage and at the same time gives the foreman much desirable information. Where spoilage is excessive on account of engineering changes, etc., the labor cost should be charged to a specially designated account.

The more usual causes of spoilage have been discussed under the topic of spoilage as a cause for direct material cost increases; therefore, it is not necessary to repeat the discussion at this point. If the accounting practice of charging to the production order the direct labor cost applied against spoiled materials is followed, the analysis should proceed in a manner similar to that outlined under the discussion of increased cost of direct materials caused by spoilage. Where the other accounting practice is followed, in which the direct labor costs are charged as a departmental expense, and to a departmental expense account, the analysis of manufacturing expenses will reveal the increases due to the spoilage.

**Charging Production with Incorrect Labor Costs.**—This cause of increased direct labor costs is largely due to carelessness and should be caught in the cost department. Increases as a result of this cause may not be of sufficient weight to make an appreciable increase in the total direct labor costs, but in an individual department a high percentage increase may warrant an investigation. The investigation is usually accomplished through an examination of the job time tickets and

payroll distribution sheets to ascertain if the rates and amounts are correct and the proper distribution has been made.

**Changes in Design, Process, Operations, Materials and Methods.**—A change in any one of these factors is likely to result in the increased use of labor, or the use of more highly paid labor. In most changes of this nature definite measurable savings should be determined to prove the value of the change. The increased labor cost may be offset by greater output, higher quality, less spoilage, cheaper materials, machines, tools, less depreciation, or perhaps a reduction in some phase of manufacturing expense. In connection with the subject of change of design, the question should be raised as to whether or not the design is economical. To solve this problem, estimates of the cost of a new or changed design, together with the estimated savings through its use must be prepared and then compared with present costs.

**Poor Supervision.**—Soldiering and loafing on the job, not following specific instructions, or not performing the work at a given time, are ways of causing direct labor costs to increase. A low rate of production caused by lack of supervision is frequently found where task time has not been set, and where wages are on a day rate basis. Careful selection and control of supervision will greatly aid in the full utilization of direct labor. An analysis should lead to an examination of the personnel department and its policies in regard to the hiring of workers and supervisory personnel.

**Idle Time.**—The customary accounting procedure is to transfer the cost of idle time to manufacturing expense by departments, or by prorating the total cost of idle time over the producing departments. A foreman sometimes takes the attitude that small amounts of idle time do not mean enough to warrant the making out of idle time tickets. He, therefore, allows the idle time to be charged as productive time to the order on which the men are working. He sometimes does this because he may not want his department charged with idle time, which would be a reflection on him. In such cases he adds the



idle time to the direct time on the production order. The subject of idleness is fully treated in Chapter 22.

**Poor Time Studies.**—When the analysis of direct labor costs leads back to the subject of time studies, it reveals a field beyond the scope of this chapter. All that can be done here is to point out that the lack of accurate and adequate time studies may not only serve to increase direct labor costs, but may result in serious labor troubles. Piece rates set too low as a result of time studies may not only cause high spoilage, dishonesty in attempting to falsify time tickets, or bribery to inspectors, but may cause the employee to operate his machine at such speed to obtain greater production that increases in costs may result. The employee may be dissatisfied with his rate or standard and may resign. If employee dissatisfaction is general, labor troubles may follow.

There is also to be considered the undesirability of making frequent changes in rates because of inaccurate time studies. Fluctuating costs and output, low morale, and general confusion are the result of this practice.

It seems unnecessary to point out that time studies for rate setting require a job evaluation. This procedure will assist in standardizing rates for similar jobs, will reduce dissatisfaction in this respect, and will also enable wage increases to be planned intelligently, based upon the job value and length of service.

**Defective Equipment, Machines, Tools and Materials.**—Although it is admitted that these factors should never make their appearance, they do exist, sometimes as a result of carelessness, undervaluation of their importance, or as the result of short-sighted policies. A machine that is known to be in bad condition may be left in that condition, and the operator may be told to do his best because the company feels that it is unwise to make the extensive repairs needed. This condition should not exist unless for a very substantial reason. Sometimes, where any one of several grades of a material can be used, the selection of the cheapest grade is not always an economy. This fact may be developed through analyzing the labor costs. Poor

materials may require considerably more care and patience, or a higher quality of tools or equipment to fabricate than would a better material. By the use of a higher grade of material, the increased output might more than offset the increased material cost.

**Excess Supply of Labor.**—The foreman usually has difficulty in getting an adequate supply of labor, and once he has his department manned to suit his needs, he is more than loath to dispense with any part of his labor. He will use every legitimate method to retain his department intact. To this end the foreman will sometimes put high-priced labor on a low-priced job, and he will frequently break down jobs to the point where two men are required to do the work of one man. This is particularly true where piece work is being done. Each man will be allowed to make almost his guaranteed amount and will, of course, receive his day rate minimum. The foreman sometimes covers his tracks by taking a piece rate employee and putting him on a day rate job which he may report as expense labor.

If the plans of the production control department include the careful scheduling of the labor required, a foreman cannot retain an excessive supply of labor. There should be a sufficiently close tie-up between the production control, the operating and the employment departments, that when the monthly production schedule is issued, one of these departments may be in a position to recommend the reduction of excess personnel.

**High Labor Turnover.**—This factor will make its appearance as a cause of increased direct labor cost as frequently as any other cause. There are so many ways in which high labor turnover may affect the progress of the plant that it will not be possible to list all of the considerations which should be examined in this analysis.

High labor turnover may be caused by poor selection, which may be due to labor shortage, lack of accurate job specifications, or lack of centralized employment or wage policies. Such conditions make it difficult to retain the better grades of labor. Working conditions or the reputation of the plant may also add

to the difficulty of obtaining high-grade employees. Instability of the business, known financial uncertainty, failure to pay wages promptly, seasonal operations, managerial policies referring to discipline, promotion, wages, lay-off, penalties, vacations, retirement, sickness and accident, as well as hazard of the work, location of the plant, and attitude toward unionism may be considered as reasons for high turnover.

Other factors causing high labor turnover which may be found upon analyzing direct labor cost are: lack of opportunity, character of supervision, inefficient training, and personal reasons. The increase of labor turnover would probably be reflected through the increased unit cost of lowered production or wage increases designed to reduce the turnover. Other ways in which labor turnover may affect cost will be brought out in the discussion of manufacturing expense.

**Poor Wage Payment Plan.**—A poor plan of wage payment will result in increased labor costs not only when day rates are being used instead of piece rates, bonuses, or incentives, but also when the plan is not based upon scientifically determined tasks or standards of output. When the analysis leads to a consideration of the wage plan, a careful study must be made to determine the underlying factors which should form the basis for the plan of wage payment. The subject should then be studied not only from the standpoint of an economical wage system, but also from that of the effects on the workers. In an industry manufacturing electric products, the workmen in a certain department were being paid on a piece rate basis. It was decided to change the wage payment plan to that of a group bonus on the production of the entire department. This plan brought substantial increases in direct labor costs, created dissatisfaction on the part of the employees, and was eventually changed back to the piece rate plan. The employees were better satisfied with the piece rate plan because it recognized individual effort and also allowed them to compute their earnings daily.

**Labor Troubles.**—Dissatisfaction and dissension within the plant, strikes, walkouts, and sit downs may require additional labor to be brought in and trained. These factors may bring

about an increase in wage rates and may lower production or increase spoilage. This subject is so closely related to the subjects already discussed, such as wage increases, time studies, working conditions, and wage payment plans, that no further discussion is needed to stress its importance.

**Miscellaneous Causes.**—Dishonesty among employees and supervisors may result in overpayment of wages through payroll padding, or collusion.

Under this heading might also be mentioned a factor which undoubtedly exists to some extent in every manufacturing plant, that is, work being done by employees for other employees and friends, and the time charged on a production order. Although the amount by which direct labor cost is increased under this condition may be small, it is cumulative. This personal work is difficult to discover in most cases, particularly if the foreman does not object or makes no attempt to prevent this condition.

Mixed sexes, change from machine to hand labor, or vice versa, poor or inadequate records and cost systems, increased working hours, or overtime may also be causes for increased direct labor costs.

**Decreased Direct Labor Costs.**—The second division of the analysis of direct labor costs is that of decreased labor costs. The factors which would cause a reduction in labor costs are essentially the opposite of those which cause an increase. For that reason it does not appear necessary to discuss these factors. As in the case of decreases in direct material costs, decreases in direct labor costs should not be accepted as due to increased operating effectiveness without a very careful scrutiny of the reasons for the decrease. It occasionally happens that instead of economy of operation being responsible for decreased labor costs, they are the result of a maladjustment which may work out in a serious way in some other phase of operations.

For instance, decreased labor costs due to changes in materials, design, or inspection may, at first, appear to be the result of an operating economy. The effects of the changes may later become evident through decreased sales, increased com-

plaints, or an increased amount of returned products. A reduction of direct labor costs accomplished by the resetting of rates or changing of wage payment plans may at first appear to be a sound idea, but decreased production, lower quality, strikes, or other troubles may be the ultimate results of such changes. The great importance of labor relations makes it undesirable to base wage payment policies on false premises or suppositions.

The necessity for making an analysis to determine if the reduction in labor costs is based on sound managerial principles is therefore evident.

## CHAPTER 17

### CONTROL OF POWER COSTS

**Waste in Power Generation.**—It is estimated that American industry has invested approximately five billions of dollars in boilers and boiler equipment for the production of steam and about eight hundred million dollars in prime movers and generating equipment.

It is claimed by outstanding power engineers that a large percentage of this investment is actually consuming the profits of those concerns in which the equipment is installed. Conservative figures show that the loss sustained by the average manufacturer through the inefficiency of his power plant varies from 30% to 50% of the power developed; in many individual cases the loss is much greater.

It is impossible to estimate the amount of money lost yearly by business corporations in the operation of their power plants and the development of motive energy to drive their manufacturing establishments. This is a field in which much research is required, as pointed out by one of America's leading power engineers, David Moffat Myers, in his recent book.<sup>1</sup>

Not so many years ago the average boiler efficiencies in industrial power plant production was approximately 62%, but this percentage has been increased in recent years to about 80%. This increased efficiency is the result of research in the field of industrial power development, the improvement of plant design and equipment, and the selection of the proper type of fuel for the particular plant in question.

There are certain unavoidable losses in power plant operations and the generation of motive energy which cannot be eliminated. Nevertheless, it is possible, through scientific operation and study, to reduce the cost of developing motive energy, or greatly increasing it for the same expenditure.

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<sup>1</sup> Reducing Industrial Power Costs, McGraw-Hill Book Co., N. Y., 1935.

If the cost of manufactured commodities could be contrasted with the cost of lost time, delayed production, reduced output, and increases in other elements of manufacturing costs caused by inefficiencies in the power plant and its operations, the true significance would be realized of an economical supply of power. There are many additional ways in which power plays an important part in the manufacturing plant—for instance, the dissatisfaction of piece workers unable to earn their normal wages when machines are shut down because the power supply has been cut off; the possibility of spoiling work in process or treatment, due to power failure and the inability to keep promised delivery dates. These reasons may greatly increase manufacturing costs and reduce the smoothness and effectiveness of operation of the entire organization.

**Executive's Attitude Toward the Cost and Supply of Power.**—The average industrial manager is interested in power plant operations only to the extent of seeing that the factory is furnished with a constant and definite supply of power to drive the machinery for production. He should, of course, be vitally concerned regarding the economical production or purchase of the required power and aware of the important data which can be obtained through records of power development and consumption. Unfortunately, because of a lack of knowledge he is seldom interested in the economies of power plant operations. Because of this attitude, excessive costs will be found in the majority of concerns producing their own power. The cost accountant, being a subordinate and sensing the manager's point of view, also ignores the subject and makes but scant provision for the collection of usable data on power plant operation. The total cost of power plant operation is generally available, although the arrangement of the individual items of this total is such that it cannot be analyzed easily.

This makes it difficult to study the detailed cost of power production in order to determine where and what costs are excessive. It is of little interest or help to be able merely to compare the total cost of production over two periods and determine that a certain increase has taken place.

**Methods of Producing Power.**—Motive force in some form is required by most industrial concerns in the manufacture or assembly of their products. The average manufacturing concern produces its own power, while many smaller plants rely on the public utility company for their supply. There are three primary sources of power, namely, steam, water, and oil. Each one of these sources may be used in a prime mover as an independent power unit, or converted into electrical energy. As prime movers, there are steam turbines, steam engines, hydraulic turbines, internal combustion engines, and diesel engines, each of which may be utilized for the development of motive energy depending upon the economic power requirements of the individual plant.

**Functions of the Power Division.**—In the average manufacturing plant generating its own power, the power division is responsible for the following activities:

1. To develop and maintain an adequate supply of power to operate the plant machinery and equipment. In a particular plant, various forms of power, such as steam, electric, gas, water, and compressed air or rotary power may be included.
2. To supply heat, electricity, live steam, compressed air and water used in processing, or for other purposes. Many processes require the use of heat for drying, electricity for driving motors, plating or welding, live steam for vulcanizing, gas for operating annealing furnaces; compressed air for operating pneumatic hammers and tube systems; and water for hydraulic equipment for fire protection and drinking purposes.
3. To supply all refrigeration required. Many types of manufacture require refrigeration during the processing of materials and often for drinking water systems, and cafeteria or lunch rooms as well.
4. To supply power for the facilities required to operate radiation, air conditioning, ventilation, or lighting sys-



tems. All manufacturing industries require heating and lighting service and many of the larger industries operate air washing and ventilating systems as a safeguard to the health of their employees.

5. To perform such maintenance work on the power equipment as may be included in the scope of their responsibility. In many plants the maintenance division is responsible for the upkeep of the power equipment.
6. To keep all necessary records of power operations. This function may include records of pressures, horsepower developed, boiler efficiencies, evaporation and coal consumed.

In many industries the power demand and the character of the manufacturing processes may modify the list of functions suggested. The plant requirements and the management's policies will be the determining factors as to what functions are included in the power activity in the particular plant.

Because the industrial power plant is considered the nerve center of production, management should make use of every available device to produce an economic, as well as uninterrupted, supply of power. Power development is a fertile field for management research in cost reduction.

**Cost of Power.**—The cost of power is normally based on quantity required and the load factor. It is the sum of the costs to produce the power and the fixed charges.

*Developed Power*

- A. Cost of fuel
- B. Cost of operating labor
- C. Cost of maintenance
- D. Cost of operating supplies
- E. Cost of supervision
- F. Depreciation
- G. Insurance
- H. Taxes
- I. Interest on investment (if included in cost)
- J. Cost of operation transmission equipment (in some cases)

*Purchased Power*

- A. Utility company's bill
- B. Fixed charges in connection with such space and equipment as may be required, such as transformers, panels, etc.
- C. Maintenance and upkeep of equipment

In the industrial plant where steam is generated for the development of electrical energy and for processing operations, it is always desirable to determine the cost per pound of steam and the cost per kilowatt of electrical energy. In some cases where all steam is converted into electrical energy, the cost of power plant operations is charged to the various departments on the bases of meter readings of the electrical energy consumed in each department. This method, while in general use, is not desirable, because power plant inefficiencies are seldom revealed, as is the case where the cost of a kilowatt developed is determined daily, weekly, or monthly. It is of course always desirable and necessary to determine the cost of steam and electricity separately, so as to detect cost fluctuations and determine their causes.

In cases where the power plant furnishes steam for processing and for the production of electrical energy, the unit cost per pound of steam should be determined. Flow-meters should be installed in the departments or at the operation, or process, and the cost of steam consumed should be charged at the determined rate.

In some cases the steam consumption must be estimated. Nevertheless the cost of process steam must be deducted from that which is converted into electrical energy so that the cost of electrical current may be accurately obtained. Steam used for radiation, whether exhaust or line, must bear a certain cost and be taken into consideration when determining power costs.

**Purchasing Versus Generating Power.**—Every manufacturing plant must, at some time or other, be faced with the question whether or not it is more desirable to buy power from a central power station, or manufacture such power as may be needed. No fixed rule can be established to guide the individual manager in deciding it. Each case must be considered separately; many factors which may influence the decision in one plant will not be found in another plant. It must be remembered that a plant operating at a high load factor can produce a unit of energy at a fraction of the figure obtained when operating at a low load factor. Also, a factory may

require large amounts of power during certain periods of the working day and only a small amount during the remainder of the time. The load factor is determined by dividing the average power load by the maximum power load.

Because of the economy of diesel engines in small sizes, some industrial plant managers have jumped to the conclusion that they can generate their own power more cheaply with diesels than to purchase it from a utility company, but again the load factor plays an important part and must be carefully considered.

In certain cases it may be possible to schedule the consumption of electrical energy so that it will not conflict with peak load periods of the utility company which is serving the area, and under such circumstances the power rates may be reasonably low.

Inasmuch as there is no formula for determining whether or not motive energy should be purchased or developed, it is recommended that services of a competent engineer be secured before arriving at conclusions. However, the following factors should be considered:

1. Adequacy of present supply of power.
2. Dependability of present power supply.
3. The load factor.
4. Cost of present power supply.
5. Anticipated requirements for power within the life of the present equipment.
6. Cost of necessary additions to provide adequate power.
7. Cost of space and investment in power plant equipment.
8. Financial condition of the concern.
9. Anticipated costs of maintaining present equipment during its remaining life.
10. Extent of seasonal operation.
11. The requirements for steam, gas, air, and electricity in processing, refrigerating, heating, and air conditioning.
12. The adequacy of the supply of purchasable power.
13. The dependability of central station power supply.
14. The cost of central station power.
15. The potential supply of central station power.
16. The necessity and cost of stand-by equipment.

*Factors Favoring the Purchase of Power*

- A. Initial investment in the power plant:
  - (1) cost of space
  - (2) cost of power plant equipment
  - (3) availability of capital
  - (4) interest on the investment
  - (5) fixed charges
- B. Cost of supervision and labor
- C. High cost of fuel
- D. Cost of handling fuel and ash removal
- E. Low load factor

*Factors Favoring the Private Development of Power*

- A. Where large quantities of steam or heat are required in processes or operations
- B. Where waste or by-product can be used for fuel
- C. Where fuel may be obtained at a low price
- D. Where there is a likelihood of interrupted service by the utility company

A thorough and accurate study should be made of the cost to generate power in the company's power plant and weighed against the utility company's contract to deliver electrical energy, or other type of power, before any definite conclusion is reached regarding its development or purchase.

The available supply of purchasable power must be considered in relation to present needs and possible future demands, as well as with the steadiness of the supply. If the public utility company which supplies the power is not fully equipped with auxiliary units, the supply may be shut off at any moment because of break-down, lack of fuel, strike, storm, flood, or other causes, which, of course, will prove embarrassing and perhaps costly to the purchaser.

**Power Plant Equipment and Machinery.**—Many industrial concerns begin their power plant operations under a decided handicap because of unsuitable equipment which has been installed. They fail to realize the necessity of securing the advice and counsel of a qualified combustion or power engineer in the selection of the proper equipment for the specific type of manufacturing establishment.

The amount of power and the load are not the only factors in determining equipment requirements. The type of product, the character of the operations and the process, the nature of

the various forms of motive energy or power required, cost of power, climatic conditions, fuel available, location of manufacturing establishment, and a host of other factors have a direct bearing on the equipment required. Likewise, there are many devices obtainable which are presumed to be valuable in the reduction of power plant operating costs. They are worth while for the most part, and will prove an economy if the concern is in a position to make full use of them. It is not economical, however, to purchase such equipment as superheaters, preheaters, mechanical stokers, etc., until it can be definitely proved that they are a real economy in specific power plant operations.

Granted that the cost of installing these devices after the plant is under operation is greater than the initial installation cost would be if installed along with the other equipment, it is desirable to study power costs over a sufficiently long period in order to be reasonably certain that such equipment will be a good investment and reduce the cost of power. When the management has decided that the use of these devices would result in savings, the selection of the best type and kind for the particular plant should be left to a competent engineer. Even with this fact established, experiments may be made and tests run before the final purchase.

**Reducing the Costs of Power Plant Operations.**—Because of the enormous investment in the average industrial power plant, and the great number of plans of installation in which money can be literally thrown away, it is the duty of every industrial manager to insist on a power plant survey for the purpose of determining whether or not the plant is operating efficiently and at the lowest possible cost.

David Moffat Myers<sup>2</sup> sets forth the most inclusive set of data which may be obtained through an industrial power plant survey.

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<sup>2</sup> These data appeared in *Factory Management and Maintenance*, Volume 93, No. 10, pp. 130, 131, October, 1935, and are reproduced through the courteous authority of McGraw-Hill Book Co., N. Y.

DATA TO BE OBTAINED THROUGH AN INDUSTRIAL  
PLANT POWER SURVEY

General Factors: A. Location; B. Kinds of Products; C. Full Rated Capacity of Production; D. Production Hours and Work Periods.

GENERATION:

*Fuel*

1. Kind of fuel consumed, and grade of each: coal, oil, gas, waste fuels.
2. Proximate analysis and B.t.u. of fuels used.
3. Delivered cost per 2,000 lbs.; per gal.; per 1000 cu. ft.
4. Applications of each fuel: steam generation; metallurgical furnaces; others.
5. Quantity of each fuel, and actual cost per year and by months for typical periods of factory production.
6. Method of storage. How much available at plant.
7. Fuel and ash handling equipment. Describe.
8. Other fuels available: prices and qualities.

*Steam*

9. Pounds generated per day and year. Maximum per hour demand. Report for same periods as in Item 5. Draw daily and monthly chart of steam production.
10. Actual evaporation per unit of fuel, per month, and per year.
11. Actual monthly efficiency of boilers and furnaces.
12. Fuel cost per 1000 lbs. of steam, actual.
13. Percentage of CO<sub>2</sub> at boiler uptakes and temperature of escaping gases.
14. Pressure and temperature of steam generated.
15. Temperature of feed water to boilers or economizer, and from economizer.
16. Anticipated changes in steam requirements.
17. Any chance to sell or buy steam?

*Boiler Plant*

18. Number and location of boiler plants on property.
19. Number of boilers.
20. Capacity of each boiler—water heating surface, sq. ft.
21. Type and make.

22. Age, condition, maximum working pressure allowed.
23. Height of setting.
24. State whether equipped with economizers, air preheaters, mechanical soot blowers.
25. Is draft forced, induced, or natural? Give type of chimney, diameter and height.
26. Combustion equipment: hand-fired, stokers, oil burners, pulverized coal, gas. State make, type, capacity and age of combustion equipment.
27. Combustion control equipment—automatic; make, type.
28. Boiler house auxiliaries: feed pumps, fans, blowers. How are they driven? How is exhaust from auxiliaries used?
29. Feed water heater, type and capacity. Percentage make-up water to boilers: summer, winter.
30. Raw make-up water, source and cost. Describe treatment and troubles. Give quantity, if possible.
31. Head room and floor space in boiler house. Available space for new units. Available space adjacent to boiler house.
32. What daily records of operation are maintained? What instruments are used for securing these?
33. Boiler house force and payroll.
34. Maintenance, repairs and supplies for the above typical period (Item 5).

### *Electrical Energy*

35. Total kw-hr. generated in typical year (same period as Item 5).
36. Total kw-hr. purchased in typical year (same period as Item 5). Total cost.
37. Secure or prepare load curves of generated and purchased energy, continuous daily, monthly.
38. Secure copy of contract under which electricity is purchased, with sample bills and alternate schedules.
39. Describe briefly electrical system, a.c. and d.c. Number and rating of transformers.
40. Load factor and power factor maintained for both generated and purchased power.
41. Power factor corrective equipment: number and rating of capacitors and synchronous motors or condensers.

42. Anticipated changes in electrical requirements.
43. Opportunities for selling or exchange of power.

#### *Power Generating Units*

44. Describe each power unit with its generator, including type, capacity, make, age, condition, water rate, initial and back pressures carried.
45. Engine room auxiliaries. List and describe.
46. Give same information for prime movers with mechanical drive.
47. Report kw-hr. generated by each main unit in period covered by Item 5.
48. Schedule of hours of operation and output of each unit.
49. Condensers: type, vacuum carried, and units served.
50. Disposition of exhaust steam from each unit: process, heating, to condenser, to atmosphere.
51. Circulating water: source, temperature, how cooled.
52. Is warm circulating water used for process?
53. Steam driven air compressors: pressure, capacity, type, make, age, condition, hours of operation.
54. Maximum steam pressure and temperature permissible on each unit.
55. Give number, make, rating, age, condition of all diesel, water power, and gas engine units.
56. Space available for additional units in present building.
57. Power house force and payroll.
58. Cost of maintenance, repairs, and supplies for chosen period (Item 5).

#### APPLICATIONS:

##### *Power*

59. List all motors and the machines driven. Give type, size, voltage, speed, make, condition, and actual test of load on each motor.
60. Electric lighting. Give number of lamps, type, volts, watts, rating.
61. Chart energy demand curve and schedule of use for all electric furnaces, ovens, and heating devices.
62. Is plant motored for individual machine, or lineshaft drive? Describe drives.
63. Give type and rating of largest motor drives that operate continuously during working day.



64. Are various manufacturing departments separately metered for electric consumption? Give data.

### *Heating*

65. Amount of steam for building warming, by months. Pressure used. Is it live or exhaust steam? Maximum hourly demand. Distance of farthest point from power plant. Heating system employed: direct, indirect, unit heaters, vacuum-return, zoning, gravity return system.
66. Amount of steam for process, by months. Maximum amount per hour. Temperatures required. Steam pressures employed. Could these be lowered? Is live or exhaust steam used? Hours usage per day and per week. State nature of processes, describing briefly as possible.
67. Hot water requirements, gallons per month. Maximum hourly demand. Is live or exhaust steam used? Pressures. Are heat exchanges used to reclaim heat from discharged dirty water? Could water be heated and stored at night?
68. State quantity of clean hot drips wasted or returned to boilers or to other uses.
69. Quantity of exhaust steam wasted to atmosphere at what periods.
70. Is live or exhaust steam metered to departments or processes? Secure these records.
71. State kind, quantity, and cost of fuels burned directly for processes, heating buildings, ovens, or dry rooms and in metallurgical furnaces. Give temperature of exit gas for consideration of waste heat boilers.
72. Indicate nature of heating difficulties or deficiencies.
73. Plot continuous chart of all steam uses, noting pressure of each.

### **COSTS AND SAVINGS:**

74. Net cost of removing and disposing of any old equipment to be discarded.
75. Cost of new buildings, or changes in present buildings, excavations, foundations.
76. Secure manufacturers' prices on all new steam, power, and electrical equipment for each plan studied.

77. Cost of installation of all new equipment.
78. Cost of electrical wiring, transformers, switchboard, and other electrical connections and incidentals including proper complement of instruments, installed.
79. Cost of all steam, exhaust, water, air, and gas piping and insulation installed.
80. Cost of all breeching, flues, uptakes, ducts, and chimney if needed, all installed.
81. Cost of all recording, integrating, and indicating instruments needed.
82. Allowance for engineering costs and contingencies.
83. For each plan offering large savings make thorough engineering cost analysis. Develop total capital expenditure for each, with annual savings in operation, fuel, maintenance, and labor. Tabulate for comparison.

To quote Mr. Myers again: "Intelligent planning, painstaking execution of the work involved in making a survey are prime essentials in the securing of adequate and reliable data." He goes on to point out the value of the analysis—"such a survey may also be required in order to determine possibilities that lie in the existing plant; to form a groundwork of facts on which to base recommendations for economical betterment; to meet intelligently conditions that require replacement of equipment or expansion of facilities; or as the basis for the design of an entire new plant."

**The Power Plant.**—An average power plant may utilize boilers and a steam engine, or an internal combustion engine to supply the motive power for manufacturing. The power plants of the majority of manufacturing concerns produce steam as a form of direct power, or generate electricity to supply the motive energy for the manufacturing plant. In order that the analysis of costs may prove of most practical value, it seems desirable to confine its scope to this typical or majority type. It should be understood that where different forms of power are supplied, a slightly different classification of power plant accounts will exist. However, the general and

most important cost items to control will be somewhat similar in each type of plant.

**Classification of Power Plant Accounts.**—In Chapter 6, there appears a classification of manufacturing cost accounts which, while general in nature, may be used in the average industrial plant. Through these accounts, adequate information may be obtained upon which to secure cost control. Below is a restatement of those accounts which may be used in accounting for the cost of power plant operations. For convenience of operating and accounting, the subject of power plant costs has been divided into two major groups: those costs dealing with boiler room operations, and those costs dealing with engine room operations.

**Titles for Power Plant Accounts.**—The account titles which would normally appear under the division of boiler room accounts are as follows:

#### CLASSIFICATION OF BOILER ROOM ACCOUNTS

- Supervision
- Labor
- Maintenance of Boilers
- Maintenance of Furnaces
- Maintenance of Buildings
- Maintenance of Superheaters, Economizers, and Air Heaters
- Maintenance of Fuel Burning Equipment
- Maintenance of Feed Water System
- Maintenance of Draft System
- Maintenance of Engine Room Piping
- Maintenance of Ash Handling Equipment
- Boiler Room Supplies
- Fuel
- Water
- Light
- Taxes
- Insurance
- Depreciation of Equipment
- Depreciation of Buildings

## CLASSIFICATION OF ENGINE ROOM ACCOUNTS

Supervision

Labor

Maintenance of Steam Turbine

Maintenance of Steam Engine

Maintenance of Electrical Generators

Maintenance of Air Compressors

Maintenance of Pumps

Maintenance of Hydraulic Machinery

Maintenance of Refrigerating Machinery

Maintenance of Air Conditioning Equipment

Maintenance of Pipe Lines

Maintenance of Transmission Equipment

Maintenance of Buildings

Perishable Small Tools

Engine Room Supplies

Lubricants

Light

Taxes

Insurance

Depreciation of Equipment and Machinery

Depreciation of Buildings

**Sources of Power Plant Cost Information.**—The information needed by the management to control power plant operations is derived from two main sources, namely, the cost accounting division and the power engineer. The cost accounting division supplies information regarding the costs of labor and materials consumed in power plant operations for the given cost period. The power engineer is responsible for the collection, assembling, and recording of the technical data on power plant operations. Such matters as steam pressures, evaporations, losses, gases, boiler efficiencies, superheating, and various meter readings, come under his control; also fuel analysis, test, and experimentation; analysis and test of water, purification, filtering, preheating, and pressures. The cost and power divisions exchange information in order that the two activities may compile the necessary reports required by management.

Other data may be supplied to management by either of these activities in the form of statistical studies. Such studies usually pertain to a single phase of power plant operations and are compiled to show a comparison of technical performance over a period of time. Such reports may cover the total steam developed over the period of one month, its distribution to turbines, auxiliary engines, radiation, work in process, losses, etc. A copy of the form used in a technical statistical study is shown in Figure 22. A portion of the information shown in this report is made available through certain weekly and daily reports submitted to the power engineer from the power house foreman or superintendent. Samples of these reports will be shown later in the chapter.

**Analysis of Boiler Room Costs.**—The simplest and most effective way of making the analysis of the boiler room costs is to take each account set up under this heading and analyze it to determine of what elements the account is composed and for what reasons it may fluctuate.

It is understood that the basis for comparison must be the estimates furnished by the power engineer and the records of performance covering present and preceding periods.

**Supervision Account.**—This account normally includes the salary of the boiler room foreman, a portion of the power engineer's or master mechanic's salary, and sometimes certain technical assistants' salaries. It is relatively fixed, changing usually only as wages change for the individuals classified under this account.

**Boiler House Labor.**—This account usually includes coal passers, firemen, and ash handlers. In this case it has been assumed that hand rather than mechanical labor is used in the boiler room. Major causes for fluctuations of labor costs in the boiler room are due usually to changes in wages, amount of help used, or rate of labor turnover. If proper job values have been determined and are used as a basis for wage payment, there should be no unwarranted fluctuations in this account. It is possible, however, that when a low grade of

# MONTHLY BOILER HOUSE REPORT OPERATION

MONTH OF \_\_\_\_\_ 19\_\_

ITEM	19__	19__	% CHANGE	
			INCREASE	DECREASE
COAL USED IN BOILERS FOR PROCESS STEAM <small>lbs</small>				
COAL USED IN BOILERS FOR HEATING <small>lbs</small>				
COAL USED IN BOILERS FOR BOILER HOUSE AUXILIARIES <small>lbs</small>				
TOTAL COAL USED IN BOILERS <small>lbs</small>				
COAL USED FOR BANKING BOILERS <small>lbs</small>				
TOTAL COAL USED FOR BOILERS BANKED & IN SERVICE <small>lbs</small>				
ASH REMOVED <small>lbs</small>				
AMOUNT OF PROCESS STEAM DELIVERED <small>lbs</small>				
AMOUNT OF STEAM USED FOR HEATING <small>lbs</small>				
AMOUNT OF STEAM USED FOR BOILER H'SE APPL. <small>lbs</small>				
TOTAL AMOUNT OF STEAM PRODUCED <small>lbs</small>				
AVERAGE STEAM PRESSURE <small>lbs. PER SQ. IN.</small>				
AVERAGE SUPERHEAT OF STEAM <small>BTU</small>				
TOTAL HEAT OF STEAM <small>BTU</small>				
EVAPORATION PER LB. OF COAL AS FIRED <small>lbs</small>				
EQUIVALENT EVAPORATION PER LB. OF COAL FROM RATING <small>lbs</small>				
% BOILER RATING BASED ON B.H.P. IN SERVICE <small>%</small>				
% BOILER RATING BASED ON B.H.P. IN SERVICE BANKED <small>%</small>				
% BOILER RATING BASED ON BOILER CAP. INSTALLED <small>%</small>				
AVERAGE HOURLY B.H.P. IN SERVICE <small>B.H.P.</small>				
AVERAGE HOURLY B.H.P. BANKED <small>B.H.P.</small>				
BOILER CAPACITY INSTALLED <small>B.H.P.</small>				
NUMBER OF BOILER FIRES BUILT				
EFFICIENCY OF BOILERS <small>%</small>				
EFFICIENCY OF BOILER PLANT <small>%</small>				
ELECTRICITY CONSUMED FOR LIGHTING <small>KWH</small>				
ELECTRICITY CONSUMED FOR POWER <small>KWH</small>				
TOTAL ELECTRICITY CONSUMED <small>KWH</small>				
COAL ANALYSIS				
MOISTURE <small>%</small>				
VOLATILE MATTER <small>%</small>				
FIXED CARBON <small>%</small>				
SULPHUR <small>%</small>				
ASH <small>%</small>				
BTU. PER LB. OF DRY COAL				

\_\_\_\_\_  
SUPT. ENGINEER

Figure 22. Form of Monthly Boiler House Report

fuel is used, additional help may be required in handling the coal or in ash removal.

The subjects of time study and employee training are seldom thought of in connection with the boiler room personnel. F. B. Gilbreth proved that labor costs in the boiler room could be reduced by proper training of coal passers and ash handlers. Other engineers have demonstrated conclusively that it is possible to effect considerable saving in the cost of fuel and the cost of boiler room operation by training the firemen. Selection of men for boiler room firing is usually based upon physical qualifications. No special knowledge of steam generation is required. It is assumed that if a man has the physical strength necessary to handle coal for eight or ten hours daily, can endure the heat of the fires, and can read a steam and water gauge, he will be a satisfactory fireman. As a matter of actual fact, it has been shown that training firemen in the art of firing the boiler and draft regulation will save sometimes as much as 25% of fuel, with a consequent reduction of boiler room costs.

In the analysis of boiler room labor costs, working conditions, hours of work, overtime, changes in shifts, length of shift, etc., are matters to be considered. While the cost of boiler room labor may not be great and the monthly or cost period fluctuations small, nevertheless an analysis should be made. It may point the way to the introduction of mechanical equipment, such as stokers, mechanical ash removers, coal conveyors, or other fuel handling equipment which may result in savings or produce more satisfactory results. The cost of ash handling labor is sometimes reduced by arrangements with a contractor to remove ashes for their value to him.

**Maintenance of Boilers.**—This account is composed of two elements, namely, labor and material. From the accounting point of view, the total of these will show the costs of maintenance, and by comparison with previous costs, fluctuations will be shown. To find out why there has been a fluctuation each element must be analyzed. Fluctuations in labor costs should be due mainly to increased use of labor. This would

indicate an increase in maintenance work performed, which may lead to the question of replacing the boilers with new ones, or a request for engineering estimates of anticipated repairs during the coming period.

Fluctuations in materials used may mean changes in market prices of materials, increased amounts of materials used, or possibly other reasons, such as were discussed in Chapter 15 under the heading of changes in direct material costs.

An accounting policy of charging replacement of parts to maintenance up to a certain value of the part replaced might affect the costs of maintenance. It is proper to expect the cost of maintenance of boilers to increase from year to year as the age of the boiler increases. However, it may be that the analysis will show maintenance costs to be so high as to warrant further estimates of life expectancy and annual maintenance costs by the power engineer, along with the costs of boiler replacement. Such a study may indicate that it would be more economical to purchase new equipment at this time than to pay the expected and continued high maintenance costs for the next few years until the equipment is worn out entirely. Other maintenance accounts should be similarly analyzed.

**Maintenance of Furnaces.**—This account is considered separately because it is desirable to watch it closely. The nature of the fuels used and the nature and construction of the fire walls determine in part the frequency with which furnaces must be relined. The intelligence and care used by firemen will determine to some extent the frequency with which grate bars and fire irons must be replaced or repaired. The labor and material cost of this maintenance fluctuates for the same reasons as do other maintenance costs. The major point to consider here, in connection with the analysis, is the desirability of changing the fire wall materials or construction, and the results to be expected from a change of fuels; also to determine the care being used in shaking the furnace and in removing the ashes.

It is well known that if the ash bed lying on the grate bars is not of sufficient depth to give some protection to the bars



from the heat of the coals, the bars will burn much more quickly. Failure to clean the grates or to remove live coals which have been shaken into the ash pit may also shorten the life of the grates and irons. It should also be remembered that draft regulation has a direct bearing on efficiency of the boiler and the cost of maintenance.

**Maintenance of Buildings.**—An analysis of building maintenance costs may show the necessity for new construction, change in construction materials, building replacement, poor quality of maintenance work, or poor materials used in maintenance. If the building is being rented, there is less desire to do maintenance work, or what is done is looked upon as unwarranted expense and may be performed in the cheapest way. This is poor economy at times unless the building is to be vacated within a period shorter than the life of the cheap maintenance. The condition of the building may affect the quality or quantity of output, the health of the worker, or the cost of maintaining the machinery and the equipment.

**Boiler Room Supplies.**—This account deals with small items of inexpensive tools and supplies in small quantities. The account should not be neglected when it shows an unwarranted percentage of increase in the amount expended. It is unlikely that supply materials will be carried out of the plant, and although they may be wastefully used, this will not appreciably increase the total cost. Small tools may be mislaid by workmen, and although small, some of them may be expensive. As small tools are kept in the boiler room and not in the tool crib, they are more easily lost and therefore should be carefully watched.

**Fuel Costs.**—The cost of fuel represents the largest expenditure in the boiler room, and fuel is the most prolific and expensive source of waste in power operations. The cost of coal includes the purchase cost, inward freight, handling from car or boat to coal pile, or storage.

**Inventory Cost of Coal.**—On the basis of planned production for the period under consideration, the amount of power

required for each machine hour of operation, the anticipated machine hours of operation for the period, as well as the amount of heat radiation required, the power engineer computes the amount of coal needed. A purchase requisition is then issued to the purchasing department showing the amount and the chemical specifications for the coal required. The purchasing department places a purchase order for the supply and specifies delivery dates. The cost division, from the copy of the purchase order received, issues a shop or standing order covering the inventory of coal. This order is charged with the cost of the coal delivered to the coal pile. The total amount of coal is divided into the total inventory cost and the unit cost, usually per ton, is found. This figure represents the unit cost at which the coal is placed on inventory, and when coal is removed from the pile, it is weighed or estimated, daily reports being sent to the cost division covering the weight of coal consumed. These amounts are charged to the coal account of the boiler room and deducted from the inventory figure on the shop order. While the causes for fluctuation in coal costs are few, they may lead to a consideration of the many ways in which these causes are produced.

If coal is purchased on contract, the purchase price is not likely to change during the period of the contract unless it is on a differential price or consumption contract basis. In case the fluctuation is due to a change in market price, it may lead to a consideration of the desirability of purchasing on contract. Coal shortages and deterioration will cause an increase in costs of coal consumed. Or where the coal contains a high percentage of moisture, the effects may be revealed by high costs.

Increase in freight or water transportation rates on coal may cause the higher price. Recourse to the Interstate Commerce Commission or the State Railway Commission is the possible remedy for such an increase, other than changing the source of supply. Increase in labor or contract cost of handling coal from steamer or car to the coal pile may also cause higher costs, and if this is the case, adoption of other handling methods should be considered. If higher costs are due to wage increase of labor, the analysis should consider the neces-

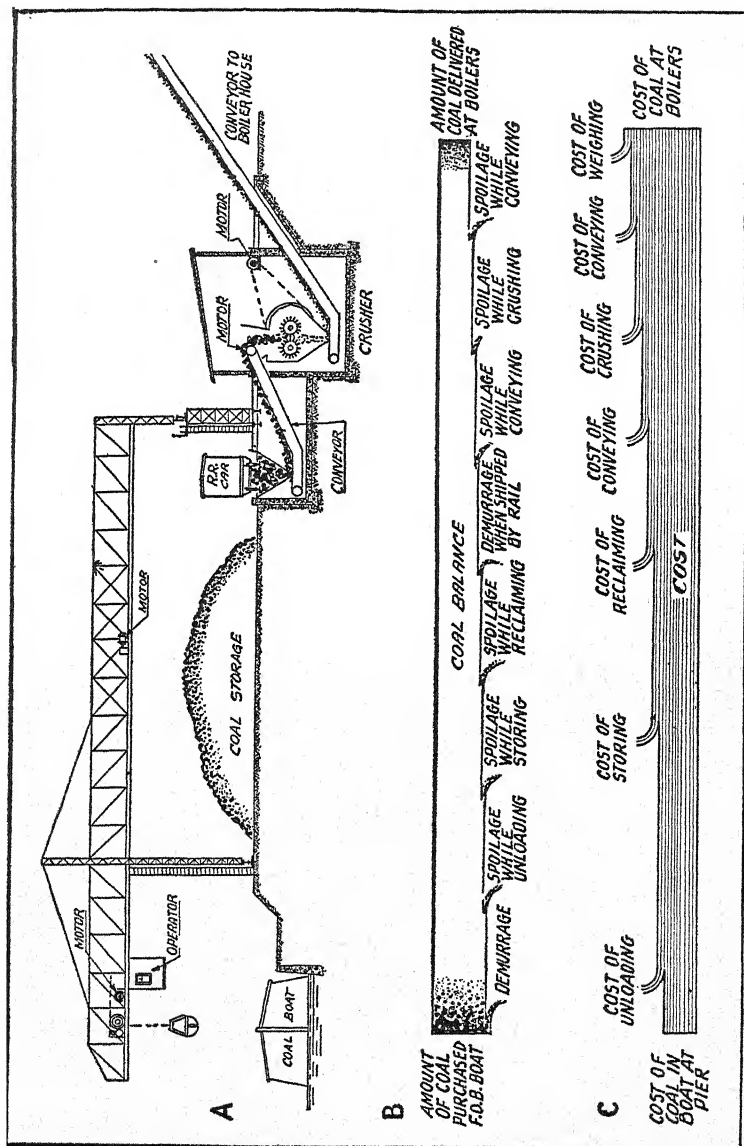


Figure 23. (A) Coal Handling Apparatus, (B) Coal Losses in Transportation, (C) Cost of Coal at Boilers

sity and justification for the increase. This cause for higher costs may bring up for consideration the question of building spur tracks, or dock construction with elevators and mechanical handling equipment such as are illustrated in Figure 23. In the handling of coal, small wastes creep in which may not be of major importance, but the consideration of them may help in making a decision regarding installation of mechanical handling devices.

**Storage of Coal.**—Before leaving this point it may be well to mention that, in piling bituminous coal, space should be left for ventilation; otherwise the heat content of the coal may be lowered, or internal combustion may result, and considerable loss may be incurred. Various methods of ventilating a coal pile are used. Where possible, some prefer to keep the coal stored under water as a protection against internal combustion and loss of heat gases through evaporation.

**Increases in Cost of Coal.**—Increases in cost of coal may be due to increased consumption. This may be the result of increased use of machinery; drying or heating apparatus requiring additional power. In case the increased consumption of coal does not show a corresponding increase in pounds of steam generated, an analysis should be made to determine the cause. The logical starting place of the analysis is with the quality of coal. A chemical analysis should be made to determine the heat content, percentage of ash, moisture content, etc. This analysis should be made before contracting for a supply of coal, or before changing boiler room equipment. Cheap coal is not always the most economical. If the quality of coal is found to be correct, then the engineering department should study the boiler room equipment to determine if the size of coal, methods of firing, etc., are correct. Because of cheaper price small sizes of coal are often purchased without considering their suitability to the boiler room equipment in which the coal is to be fired.

Poor firing may increase the consumption of fuel materially. Failure to spread the coal evenly over the firing surface may produce uneven burning of the coal, uneven heating of the

## FUEL REPORT

FUEL INVENTORY

MONTH OF \_\_\_\_\_ 19\_\_

NAME OF FUEL	RECEIVED			IN STORAGE BEGINNING			CONSUMED			IN STORAGE END			STOR- AGE CAPA- CITY TONS	MIN. STOCK REQUI- RED TONS	DIFF TONS
	TONS	UNIT COST	COST	TONS	COST	UNIT COST	TONS	COST	TONS	UNIT COST	COST				
<i>ANTHRACITE</i>															
<i>BITUMINOUS</i>															
<i>TOTAL COAL</i>															
<i>FUEL OIL</i>															
<i>TOTAL FUEL</i>															

## COST OF COAL

ITEM	TONS	COST PER TON \$	COST \$
<i>COST OF COAL IN BORT AT PIER</i>			
<i>COST OF UNLOADING COAL</i>			
<i>COST OF STORING COAL</i>			
<i>COST OF CRUSHING COAL</i>			
<i>COST OF CONVEYING COAL TO BOILER</i>			
<i>TOTAL COST OF COAL AT BOILER</i>			

## COST OF ASH HANDLING

	TONS	COST PER TON \$	COST
<i>COST OF ASH CONVEYING</i>			
<i>COST OF ASH DISPOSAL</i>			
<i>TOTAL COST</i>			

CLERK \_\_\_\_\_

Figure 24. Monthly Fuel Report

tubes, or smothering of gases. This may also prohibit free circulation of air, which will result in the coal settling into a partly burned mass from which the heating gases have not been driven off.

**Draft Regulation.**—Improper regulation of draft may cause the fire to choke and the coal to fuse into an unburnable mass which clogs the fire box and wastes the fuel, or it may cause a too rapid burning of the coal with the result that a portion of the heat gases are driven up the chimney without complete combustion. A fire that is too thick may cause loss of heat gases because insufficient space is left for combustion.

Improper shaking and dumping of the grates may cause a waste of fuel by shaking the unburned or live coals into the ash pit. Too infrequent shaking of the grates allows the ash to pack so tightly that the air circulation is partly cut off, thus permitting the unburned coal to cool and fuse, resulting in a loss of the heat gases. The ash should not contain more than 2% or 3% of unburned coal, and a periodic analysis of the ash should be made to determine the unburned coal content.

Accumulations of soot on the boiler tubes, or deposits of scale inside the water tubes may cause increased consumption of coal. Soot is a natural consequence of poor combustion, and as an insulation against heat it is estimated to be five times as effective as asbestos. Once the importance of this fact is realized, the necessity for a mechanical soot remover to keep the tubes clean will be evident.

**Purification of Feed Water.**—Scale is the impurities in the feed water deposited in the water tubes. A thickness of scale has greater heat-resisting capacity than the steel of the water tube, and its removal is extremely difficult. Water should be purified before entering the boiler to prevent the deposit of scale in the tubes. This may be done by adding certain chemical compounds, or by putting the water through a purifier before piping it into the boiler.

**Heat Losses.**—In addition, there are certain heat losses in boiler room operation which, although of no great importance

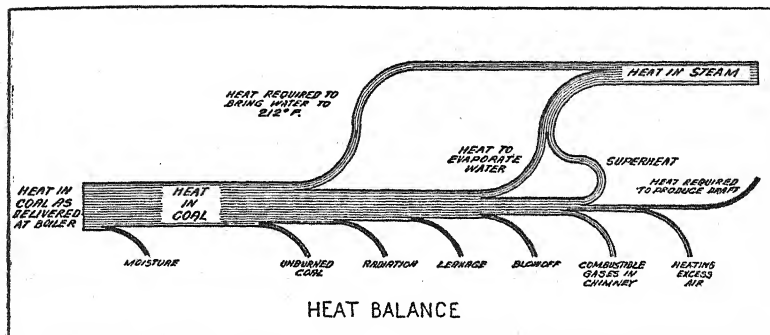


Figure 25. Chart Showing Heat Utilization and Losses Produced from Coal under Boiler

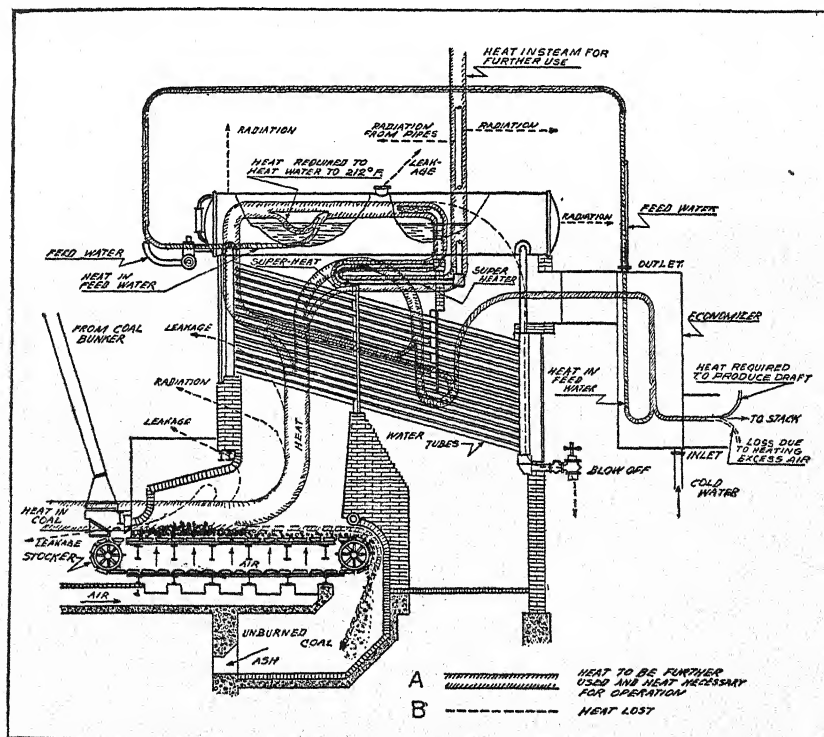


Figure 26. Cross-Section of Boiler Showing Heat Utilization and Waste

as individual cases, may in total affect materially the consumption of coal. Figure 25 represents the heat in coal, amount of this heat utilized, heat losses due to unburned coal in the ash, radiation, leakage in the fire-box or through the brick work, moisture in coal, unnecessary blow-offs, combustible gases in the chimney, and heat necessary to produce draft in the chimney. These losses should be manifest when the statistical data of boiler efficiency are examined. Figure 26 is a cross-section of a boiler and presents visually the utilization of heat and certain wastes of coal. Line A in this sketch represents the flow of heat through the boiler, and line B shows the losses during this process.

**Water.**—This account includes only the water supplied to the boiler for evaporation into steam. Water rates may change, pipes may burst or leak, and increase in steam production may cause fluctuations in this account. Causes of change may be discovered easily. Usually the water supply is limited to one or two possible sources, and while changes are infrequent, periodic analysis should be made of the cost of water and of the compounds used in its purification.

The fixed charges, consisting of rent, taxes, depreciation, and insurance, are usually predetermined for a given period and naturally do not show variations, except in rare cases. These charges may be easily analyzed if variations do occur. Fixed charges will come up for discussion later.

**Engine Room Costs.**—Inasmuch as accounts under this heading are similar, for the most part, to accounts under the heading of boiler room, it is unnecessary to go into a detailed discussion of their analysis. They should be analyzed in a similar fashion to the boiler room accounts.

One thing which should be mentioned in this connection is that carelessness and lack of technical knowledge of engine room machinery may materially increase the costs of engine room operation, and may also cause heavy loss in damaged machinery and equipment. The inefficiency of the engine room equipment should be eliminated by the engineering department, and cost control should regulate expenditures for



# DAILY BOILER HOUSE REPORT OPERATION

DATE \_\_\_\_\_ 19\_\_

ITEM	BOILERS				BOILER PLANT
	1	2	3	4	
AV. TEMP. FEED WATER, ECONOMIZER INLET					
AV. TEMP. FEED WATER, ECONOMIZER OUTLET					
AV. TEMP. FLUE GASES, ECONOMIZER INLET					
AV. TEMP. FLUE GASES, ECONOMIZER OUTLET					
AV. TEMP. FLUE GASES, AT STACK					
AV. TEMP. OF STEAM					
AV. DRAFT AT FURNACES <small>INCHES</small>					
AV. DRAFT AT DAMPERS <small>INCHES</small>					
AV. DRAFT LEAVING ECONOMIZER					
AMOUNT OF COAL CONSUMED <small>lbs</small>					
AMOUNT OF STEAM PRODUCED <small>lbs</small>					
AMOUNT OF STEAM PRODUCED PER HR. <small>lbs</small>					
EVAPORATION PER LB. OF COAL AS FIRED <small>lbs</small>					
EQUIV. EVAPORATION PER LB. OF COAL FROM AT 212°					
FACTOR OF EVAPORATION					
% BOILER RATING					
% BOILER RATING BASED ON BOILERS IN SERVICE & BOILERS BANKED					%
% BOILER RATING BASED ON BOILER CAPACITY INSTALLED					%
BOILER PLANT EFFICIENCY					%
AVERAGE FLOW OF STEAM					<small>lbs PER HOUR</small>
AVERAGE MOISTURE IN STEAM					%
AVERAGE CO <sub>2</sub> IN GASES					%
LOSS IN GASES					<small>BTU</small>
SUPERHEAT OF STEAM					<small>°F</small>
TOTAL HEAT OF STEAM					<small>BTU</small>
COLD WATER CONSUMPTION					<small>lbs</small>
AVERAGE TEMPERATURE OF COLD WATER					<small>°F</small>
AMOUNT OF WATER TREATED					<small>lbs</small>
AVERAGE BOILER ROOM TEMPERATURE					<small>°F</small>
AVERAGE OUTDOOR TEMPERATURE					<small>°F</small>
ELECTRICITY CONSUMED FOR LIGHTING					<small>KWH</small>
ELECTRICITY CONSUMED FOR POWER					<small>KWH</small>
TOTAL ELECTRICITY CONSUMED					<small>KWH</small>

OPER. ENGINEER

Figure 27. Daily Report of Boiler House Operation

labor, supplies, lubricants, etc., on the basis of engineering estimates.

**Statistical and Cost Reports.**—It is impossible to determine the efficiency of power plant operations entirely by means of the cost accounts. Certain statistical data for engineering analysis must be had. It would be difficult to set forth the exact data needed, as individual problems may affect the amount of data collected. A few of the operating and cost reports used in a large manufacturing company are shown in Chapter 14. No detailed explanation of these forms is offered inasmuch as they are self-explanatory. The sources from which the data are derived will be obvious, and the various uses which may be made of the information provided are well known. The information suggested by these forms may not be fully required in a particular concern, or certain other data not herein provided for may be essential. There need be no difficulty in devising records to supply the data, once their importance is recognized.

**Auxiliary Mechanical Devices.**—Much of the statistical data shown on the following forms is made available through the use of recording devices which are the proper means of securing accurate data, rather than resorting to individual judgment when basic facts are needed. Indicating and recording water gauges, draft indicators, and recorders, steam flow meters, steam pressure indicators and recorders, steam thermometers for superheated steam, CO<sub>2</sub> recording instruments, indicating and recording pyrometers, water meters, and a great many other devices have justified their use in many cases.

**Difficulty of Securing Boiler Room Reports.**—A problem will sometimes arise in securing information from the power house personnel. They may not recognize the importance of making out forms carefully and completely, or may fail to submit reports promptly. Corrective measures are easily applied in such cases. Since these data are so necessary in the efficient operation of the power plant and the control of power

plant costs, the necessary measures should be taken to insure the receipt of these reports promptly.

**Power Plant Operation.**—The most expensive power plant equipment cannot be relied upon to supply the power requirements unless it is skilfully operated and efficiently controlled. This requires trained labor in the boiler and engine room and expert supervision. The use of measuring and recording power instruments provides a wealth of useful information concerning different phases of power plant operations, but they are of little value unless the personnel of the division are able to read and interpret the records in terms of operating efficiency.

Information concerning such matters as coal consumed, pounds of steam pressure, temperature of feed water and flue gases may be obtained from instruments stated above. The data provided by these instruments and the records compiled from other sources must be studied and analyzed by the head of the power division as the basis for developing operating methods and control measures to bring about maximum results from power operations.

## CHAPTER 18

### CONTROL OF MAINTENANCE COSTS

**Plant Maintenance.**—Organized plant maintenance, although considered a necessary burden by a large portion of manufacturers, is, nevertheless, a decided and valuable asset when utilized efficiently and correctly. Maintenance work in any plant is performed for three primary purposes, that of plant preservation, anticipating and preventing interruptions to production and correcting, or repairing plant facilities. The great importance of adequate plant maintenance is more fully realized when one considers that present-day large-scale production is made possible only through the universal use of machines. Prevention may not be possible in all cases or at all times, but break-downs can usually be prevented by always keeping equipment in good condition. Thus, the maintenance organization must be prepared at all times to render service to the entire plant and make emergency repairs when necessary.

Maintenance work requires a great deal of organized planning, compiling data for records, inspecting plant and equipment, and preparing for any plant emergency. The three-fold aspect of maintenance work must be fully emphasized to the manufacturer, who is interested in low operating costs and the maximum efficiency of the plant and equipment.

**Definition.**—Maintenance is that function of plant activity which is responsible for repairs and upkeep of all structures, machinery, equipment, grounds, and services necessary to keep the plant in effective operating condition. While this definition is general in scope, it does, nevertheless, cover the field of maintenance.

**The Theory of Maintenance Work.**—The maintenance of plant and equipment prolongs the life of the fixed assets, and thus their value is more or less constant.

If this theory is accepted, accountants might consider maintenance costs as a charge to the reserve for depreciation of plant and equipment.

**Functions of the Maintenance Unit.**—The specific duties of the maintenance unit will vary according to the types of plant and the policies of the company in question. However, the following duties or functions may be considered as representatives of the general responsibilities assigned to a maintenance unit.

1. To keep in good condition all plant and equipment for the purpose of plant preservation.
2. To make all emergency and other repairs to plant and equipment.
3. To lubricate and clean all line shafts, motors, and other equipment.
4. To make periodic inspection of all machinery and equipment in order to detect and remove all causes which may result in breakdown or faulty production.
5. To make such adjustments and replacements as are shown to be necessary by the inspection.
6. To keep tickler records to insure inspections being made at scheduled intervals.
7. To maintain records of all equipment and machinery and of all inspections, repairs, and replacements.
8. To schedule all repair work in conformity with production and operating requirements.
9. To make recommendations to the engineering department concerning changes in processes or methods and changes in the design or use of machinery and equipment.
10. To requisition and keep on hand an adequate supply of suitable materials for all maintenance work and the necessary maintenance supplies.
11. To keep in good order and condition, all buildings, grounds, fences, pipe lines, and cables.

12. To maintain adequate watchman and fire protection services.
13. To make such estimates of maintenance work as may be required by the maintenance policy.
14. To prepare and make available at all times information concerning the care, use, and protection of the plant facilities.
15. To operate such service activities as may be assigned to the division.
16. To maintain files of building plans, maps, and charts of locations and connections of plumbing, electric, and other lines and such specifications and records as may be needed in the conduct of the division.
17. To keep the plant in a good sanitary condition and aid in accident prevention.
18. To prepare the maintenance budget.
19. To keep an adequate supply of well-trained and competent maintenance personnel.
20. To make an accurate survey of plant and equipment, and record the conditions.
21. To control all maintenance costs.

The performance of each of these functions represents the expenditures of funds, and such expenditures must be thoroughly justified in some manner consistent with the amount of money spent. Management should establish a measurement of maintenance efficiency through the budget, accurate cost data, and adequate maintenance reports all of which must be governed by definite company policies.

An excessive amount of maintenance may prolong the life of the equipment even after obsolescence sets in, while too little maintenance may endanger the production schedule.

Many concerns have adopted a policy of recognizing obsolescence in their equipment as soon as a technological improvement in such equipment has been placed on the market. Thus many machines are replaced which are in perfect mechanical condition, but the new machine is capable of producing a higher quality and quantity of product at a much

lower cost. However, if the replaced machine has been properly cared for through preventive maintenance, it will, no doubt, bring a higher sales price in the second hand market.

The managerial policy of preventive maintenance, and the recognition of obsolescence through the advancement of technology, always pays in the final analysis.

**Organization of the Maintenance Department.**—Where maintenance work is of any consequence in a plant, it is seldom desirable to decentralize the activity, that is, to have the maintenance men scattered throughout the plant under the control of the operating foremen or operating superintendent.

In cases where maintenance work is decentralized it is likely to result in :

1. Less mobility of the crew.
2. Inability to plan and schedule work accurately.
3. More delays in making repairs.
4. Less cooperation.
5. Greater costs of doing the work.

**Modern Organization Sponsors Centralized Maintenance.**—An executive, usually an engineer, is placed in charge of the maintenance activity and is made directly responsible to the factory manager, or director of manufacturing. This maintenance engineer or supervisor breaks down the activity into its principal divisions, such as (a) millwrights' division, (b) electrical division, (c) steamfitters' division, (d) carpentry division, and (e) general service division. The maintenance engineer places a foreman in charge of each of these divisions. He appoints a general foreman who, under his personal direction, supervises the division heads. Where a division is of sufficient size it is further subdivided into sections, and group leaders are placed in charge of the sections or units of the division. Through this plan of organization the responsibility for all work is fixed; definite jobs and duties may be assigned; better scheduling and planning are made possible; better co-operation with other departments is maintained; lower costs of getting the work performed are secured; and greater mobility of the maintenance operatives exists.

**Scheduling Maintenance Work.**—Speed and promptness in making repairs is essential, and can be obtained best through this plan of organization. Thus, when a machine in an operating department suddenly breaks down, the foreman of the department telephones the maintenance department office regarding the breakdown, giving the name, number, and department location of the machine. He confirms this verbal notification by a written requisition for repairs. In the meantime, the form on which the telephoned notice is written is given to the general foreman who determines the division responsible for performing that particular work and furnishes the divisional foreman with a requisition covering the job.

The division head investigates the breakdown, schedules the work, and dispatches his men to make repairs. The scheduling of repairs makes it possible for the operating foreman to plan the work of his department in order to suffer the least inconvenience from the unexpected interruption.

**Records Necessary.**—The maintenance department should keep a set of permanent records so as to facilitate the accomplishment of its work and control its several activities:

1. Maps of the property.
2. Plans and specifications of all buildings.
3. Plans and specifications of the power plant and its equipment.
4. Maps of all underground piping, power lines, and sewage systems.
5. Maps of plant power lines, electric wiring, steam pipes, water pipes, gas pipes (oxygen, hydrogen, etc.), sprinkler systems, drinking water pipes, refrigerator lines, and hydraulic lines.
6. Maps showing location of fire fighting equipment, hydrants, and fire exits.
7. Maps of shop transportation system.
8. Perpetual inventories of machinery and equipment. (Each piece of equipment should have a brass tag permanently affixed to it, bearing the department and machine numbers.)



9. Drawings and specifications of all machinery and equipment, showing the various part numbers assigned by the manufacturer.
10. Records of all inspections, adjustments, repairs, and costs.
11. Plans of department and machine layouts.

**Accounting Procedure for Maintenance Costs.**—The general rule of charging a department with all costs which can be accurately allocated against that department holds in the case of maintenance.

Standing orders (see Figure 28) for maintenance expense are issued either against the departments directly, or by classes of machines and equipment covering all departments. From this a departmental distribution is subsequently made. When a repair has been made in a given department, the time ticket of the repair man which shows the time spent, the machine symbol and number, the department number, and other desired information is sent to the payroll distribution section. When the distribution is made the ticket goes to the cost department where all tickets are summarized and amounts entered on the cost records of the standing orders. (See Figure 29.) From the standing order the departmental distribution is made. Materials used in repairs are drawn on requisitions from the maintenance storesroom. The requisitions go to the stores record section, where they are priced and extended. The necessary entries are made on the stores records from the requisitions, which are then sent to the cost department for entries on the standing orders.

No portion of the overhead cost of operating the maintenance department is charged against the department standing orders. At the end of the cost period when the total overhead costs of operating the maintenance department are accumulated, it is distributed on a predetermined basis over all production departments requiring maintenance, or on the basis of the amount of maintenance performed in each department. Figure 30 shows the usual type of standing order used for compiling maintenance costs.



**Maintenance Costs and Control.**—Few executives realize the effect that maintenance operations have on the cost of their product. An efficient, well-controlled maintenance organization will mean a great deal in the control costs of both the maintenance function and production. A maintenance organization should be supplied monthly with its costs of operations,

MAINTENANCE ORDER						ORDER NO. _____	
MACHINE NO. _____						SHEET NO. _____	
DEPT. NO. <u>1000</u>							
DESCRIPTION OF MACHINE _____							
DATE PURCHASED _____				COST INSTALLED _____			
DATE	REQ. NO.		MATERIAL	LABOR		TOTAL	
		Where there are no machine cards					

Figure 30. Maintenance Order—Cost Record

so that a measure of its efficiency may be obtained. Without a measuring rod control is impossible, and without control the organization itself is worthless.

In most large manufacturing establishments, maintenance expenditures are the largest single item of manufacturing expense, and, while justified in most cases, it must be effectively controlled through the cost accounting procedure.

The primary purposes for cost accounting and control of maintenance activities are:

1. To measure the efficiency of the maintenance function in relation to production and plant preservation.
2. To determine the relationship of maintenance costs to plant income.
3. To allocate by diffusion the maintenance expenditures to the costs of the various commodities produced.
4. To determine the relative costs of plant preservation, replacement, repairs, and service.

The cost of performing maintenance jobs should be estimated by the maintenance engineer before the work is started and the work order issued should be approved by the plant manager on all jobs where the estimates show a greater expenditure than about \$25.00 or \$30.00 except emergency repair work. At the end of each cost period an analysis should be made of the cost of each work order so issued and the results compared with the engineering estimate.

The control of maintenance costs is procured by:

1. Maintenance engineering estimate for repair and replacement jobs.
2. Analysis of all maintenance costs.
3. Maintenance budget.
4. Ratio of maintenance expenditure to the cost of productive operations.
5. Time allowance for specific work.

In connection with plant and property records, it is desirable for management to set up and maintain a permanent record for each machine and other piece of equipment so as to control the costs of maintenance, depreciation, and obsolescence. Figure 17 is recommended for this purpose. (See page 145.)

The information recorded should include among other facts:

1. A description of the property whereby it can be readily identified at any time and from which engineering and operating departments can secure reliable and complete data.
2. A record of original location and history of all subsequent relocations of the item.
3. A record of the original and supplementary costs of the items with adequate reference to all documents which support these costs.
4. A record of repairs, renewals, and maintenance.
5. Loss in value through depreciation.
6. Report of disposition through sale or otherwise.

The real value for such property records lies in their ability to furnish information when required.

The importance of maintenance from the standpoints of: (1) preservation of the plant; (2) facilitation of production; (3) maintaining the quality of production; and (4) the cost of the maintenance work, warrants a most thorough study of this department's activities, and a periodic analysis of the costs and effects of maintenance.

**Analysis of Maintenance Costs.**—The portions of maintenance costs which have been previously discussed will be omitted from this chapter, although the accounts common to that department are listed below :

- Supervision
- Technical Assistants
- Inspection
- Clerks and Stenographers
- Storeskeeper
- Watchmen and Gatemen
- Elevator Operators
- Janitors and Sweepers
- Laborers
- Oiling and Cleaning Machinery
- Maintenance of Machinery
- Maintenance of Buildings
- Perishable Small Tools
- Supplies
- Oils and Lubricants
- Fixed Charges

There are numerous other accounts which are classified under the maintenance department, such as heat, light, office supplies, and stationery. They are usually of little significance and are discussed elsewhere.

**Supervision.**—The account includes the salaries and wages of the head of the maintenance department, the general foreman, divisional foreman, and section heads. The supervision account should not fluctuate materially from month to month, except for increase in pay or changes in the number of personnel. This account should be studied in relation to other

accounts in the department. The study may be of value in determining the necessity for the amount of supervision and wages paid. For example, the cost of doing a certain kind of maintenance work may be small. If there is a highly paid supervisor in charge of this work an analysis may suggest the possibility of combining such supervision with other duties for the purpose of cost reduction.

**Technical Assistants.**—This account covers the cost of such work as designing, sketching, drawing, blueprinting, etc., as is performed in the maintenance department, and usually includes a staff of two or more skilled persons. The cost of this work should not vary between cost periods. A question might arise in examining the cost of technical assistants as to whether the work could be done in the engineering drafting room or by the engineering department technicians.

**Inspection.**—This account covers the cost of persons in the maintenance department engaged in the inspection of machinery, equipment, and plant. The work consists of making periodic examinations of machines, equipment, and buildings. The unexpected breakdown of machinery or equipment may result not only in interruptions to production, but may cause serious damage to property, or even injury or loss of life. Granted that many breakdowns occur which could not have been anticipated, opinion in general is agreed that the majority of breakdowns could have been prevented by periodic inspections.

A system of periodic inspection by the maintenance department has been introduced in many industries in the attempt to anticipate and forestall breakdowns, and thereby reduce the cost of interruptions to production.

This inspection consists of assigning mechanics or workmen skilled in this task to make a periodic examination of each piece of machinery or equipment. From the data found on the equipment cards, the maintenance office furnishes each inspector with an instruction sheet. This instruction sheet gives the name, number, description, and location of the machine, and also provides a space in which the inspector notes the present

condition of the machine, writes in detail his opinion as to what repairs are necessary, and the probable date by which the repairs will be required in order to prevent breakdowns. In the space for remarks, the inspector shows the parts needed for the repairs, and, if required, the estimated cost and the time needed to make the repairs. Should he have suggestions or recommendations to make concerning the operation, construction, speed, or other technical aspects of a machine, he writes them in the remarks column, together with the probable cause of the trouble.

**Use of Periodic Inspection Reports.**—After the inspection is made, the inspector fills out and signs the inspection report, which he returns to the maintenance office. This report is then carefully examined, and if parts which are not in stock are required to make the repair, the usual purchase requisition is made out. If it is a special job, a technical assistant is instructed to make the necessary drawing, or sketch, as the specification for making the part required. The probable time when the repair will be needed and the amount of labor required to make it are then considered.

In this connection the production control division is consulted in order that the repair work may be scheduled so as to cause the least inconvenience in the production schedule. This enables the production control division to plan accordingly, and issue the necessary instructions to the foreman of the department so that he can make such temporary changes in the use of machinery and personnel as will be necessary.

In case the estimated cost of the repair is above the set maximum, the maintenance engineer will bring the matter to the attention of the engineering department, the plant manager, or general manager, as to the desirability of making the repair in preference to purchasing a new machine. The actual costs, description, and date of each repair is recorded on the equipment card of that machine as a matter of permanent information. The equipment card serves as a basis for analyzing the cost of repairs in relation to the value of the machine and amount of depreciation written off.

**Analysis of Inspection Account.**—An analysis of the inspection account will not reveal the value of the work performed. However, the account should be examined to determine causes of fluctuation which will be due usually to changes in personnel, changes in machinery requiring more frequent inspection, or increasing the amount of inspection. The frequency of breakdowns, cost of repairs, cost of spoilage, cost of delays in production, additional life of the machinery, and other factors are to be considered in analyzing the cost of inspection.

**Clerks and Stenographers.**—This account is of minor importance since usually there are not many persons engaged in this class of work in the maintenance department. However, the account should be given due consideration if fluctuations occur.

**Maintenance Storeskeeper.**—For convenience in making repairs and withdrawing parts and supplies for maintenance work, the maintenance stores are kept in a separate stores-room. Electrical supplies, pipe-fitting supplies, repair parts for machines, etc., comprise the stores kept by the maintenance department. The account will show minor variations only at stated intervals, due to changes in wage rates.

**Watchmen, Gatemen, Elevator Operators, Janitors and Sweepers.**—The personnel represented by this account seldom changes in number, and therefore the account is more or less constant. The analysis will concern itself chiefly with determining the necessity for the amount of work represented by the costs shown in this account. Much idleness is possible in the case of janitors, sweepers, elevator operators, and particularly service elevator operators. There are many ways in which the time of some of these persons may be utilized which otherwise would be employed unprofitably.

**Labor.**—In a large manufacturing plant there is an infinite variety of work to be performed by the labor gang under the



supervision of the maintenance department. This force is likely to fluctuate numerically between cost periods, and considerable variation in labor costs may be expected. The centralization of material handling should reduce the size of the maintenance labor force. In almost every plant of any size, the work of painting fences, digging trenches, cleaning sewers, removing snow, painting outside of buildings, repairing railroad tracks, excavating for various purposes, loading scrap materials, and numerous other incidental jobs will arise from time to time. The use of low-priced common labor for this work tends to reduce the thoroughness of the planning and supervision of such work.

A large gang of labor is employed, and when a job is completed perhaps a portion of the gang is discharged or laid off. A small gang is always retained to do odd jobs and emergency work whenever needed.

An analysis of this account is difficult. In the first place, the men are often assigned to small jobs for which no time tickets are turned in. Of course, the time tickets for the total day's work will be made out and the timekeeper will distribute the individual's time to the various jobs, which are based on a conjecture, made either by himself or the foreman. The very nature of the work performed by this labor gang makes it a difficult task to get accurate time on jobs. The men are usually of a low mentality and cannot keep their own time. They are frequently so scattered about the plant that the foreman, or timekeeper, cannot arrange to obtain a record of the exact time spent on each job. Practically, this is of no great importance, but if the cost system is expected to show accurately the cost of doing various classes of work, this detailed information is necessary. The analysis will not permit a very accurate determination of the justification of a given job cost.

By the time tickets it may be found that the indirect labor should really be charged to some plant investment account. The specific job may have been the erection of a piece of machinery, or the laying of a foundation for a machine, all of which labor should be capitalized.

**Oiling and Cleaning.**—To this account is charged the cost of the labor used in oiling and cleaning machinery and equipment. The account will fluctuate very little between cost periods and will require but little attention. Oiling and cleaning machinery are very essential to enable proper functioning of the equipment, to prolong its life, and to prevent breakdowns.

The operator of a machine usually looks after the oiling and cleaning of his machine, although sometimes the maintenance oiler must go over the machine. The oiling of shafting, main drive motors, elevators, conveyors, and overhead carriers and cranes is the major part of the work performed by the maintenance oilers and cleaners.

**Maintenance of Machinery.**—This account should not be confused with the maintenance of operating machinery. It includes only such machinery as is found in the maintenance department. The same process of analysis should be followed as suggested in Chapter 21 on the maintenance of material handling equipment.

**Maintenance of Buildings.**—This account covers building maintenance in the department only, and does not refer to general plant building maintenance. It includes repairs to floors, walls, doors, windows, etc., within the department. This is usually a small account with but little need for analysis. When necessary, it should be analyzed in the same manner as are other maintenance of buildings accounts.

**Oils and Lubricants.**—The account, oils and lubricants, is one that is well worth watching carefully. Carelessness in drawing oil and in using it causes waste and increases fire hazard and accidents. The oil supply must be accessible to the oilers as a matter of time saving, and cannot be checked as carefully as other supplies.

**Maintenance Division Policies.**—The development of sound policies to control maintenance work is essential to the proper organization and operation of the division. The scope

and limits of the activity should be covered by a definite policy. Such questions as to what extent will the division participate in the design of machinery and equipment, power plant operation, installation of machinery or equipment, and the extent to which required service will be provided for within the division, or obtained from outside agencies, are representative of matters covered by the policies. Similarly, the determination of the cost of maintenance work, which may be performed without first submitting estimates to the general manager for approval; the extent to which parts replacement may be carried without specific authority; the character and extent of fire equipment and protection, are other matters of importance that should be subjects for policy determination.

**Effects of Poor Maintenance.**—When employees are working on a piece rate or bonus plan of wage payment, they are likely to complain about poorly maintained machines and equipment. They cannot make their standard of output and thus, their earnings are reduced, cost of getting out the products increased, spoilage is greater, more processed and finished goods inspection is needed, accident rates are increased, and a general feeling of discontent is visible throughout the shop. Sooner or later, if not corrected, this condition may lead to serious trouble. Poor maintenance leads to poor plant and equipment and this, in turn, leads to poor and unsatisfactory products which, eventually, result in a definite loss of business. It is therefore desirable from all points of view to organize and operate the maintenance department as efficiently as possible. A careful study and analysis of the costs of its operation will be of material assistance in the efficient direction and control of the activities of this department.

**Opportunities for Cooperative Service.**—The preventive and corrective work of the maintenance division requires the constant study of methods, causes, and conditions which make maintenance work necessary. When the inspection reveals excessive wearing of machine parts, poor construction of the machine, mechanical errors, poor materials used in machine construction, improper methods of machine operation, it is

the duty of the division to present such facts to the engineering department, together with whatever suggestions as may be helpful in correcting the condition or preventing reoccurrence. Similarly, when the maintenance mechanics discover unfavorable machine conditions, which they believe are attributable to the use of wrong materials or lack of training on the part of the operator, abuse of the machine, incorrect speed or feed of the machines, improper or poor tools, they should report the matter to the foreman, or whoever may be responsible for the existence of the condition. Occasionally poor time studies cause the worker to operate the machine at an excessive rate of speed in order to make a satisfactory wage and, as a result, the machine is usually damaged. This condition should be reported to the proper authority so that it may be corrected.

Many additional ways could be pointed out to show how the maintenance division, by virtue of the strategic position it occupies and the work it does, is provided with exceptional opportunities to render helpful service to other activities of the business. A broadminded and willing executive at the head of this activity will do much to insure the full realization of its fruitful possibilities in this direction.

## CHAPTER 19

### CONTROL OF INSPECTION COSTS

**Definition.**—Inspection is the art of comparing anything with a given standard for that thing, to determine the degree of similarity within specified limits of that thing to the given standard.

Inspection is, in other words, control of quality and its specific purposes are the discovery of variables, the determination of their causes, and the recommendation of methods for their elimination or control.

**Theories.**—There are three important theories fundamental to the function of inspection which are basic to all quality control:

1. The first theory maintains that the quality of a whole is dependent upon the quality of the constituent parts and the efficiency of the workmanship involved in making that whole.
2. The second theory holds that relative perfection can be maintained only through keen constant examination, exacting comparisons, and definite measurements.
3. The third theory states that the cost of inspection is directly proportional to the degree of precision required, the amount of examination desired, and the caliber of the human element involved.

**Importance of Inspection.**—Absolute perfection cannot be obtained and therefore in industrial production quality can be maintained only in relation to an equivalent degree of perfection and the realization of that equivalent can be obtained only by comparison with a definite, set standard.

Inspection, or quality control, serves two main objectives, i.e., (1) the company's interest in the satisfaction of the cus-

tomer, and (2) the development of a product which measures up to a standard of performance and serviceability set by the company.

The first phase of developing efficient quality control is the interpretation of the public's requirements in terms of the product manufactured and the failure of quality control is the cause for selling a mistake.

The general level of quality of a product is determined initially by the price which the public is willing to pay for it. The quality standard is expressed to the operating organization in terms of managerial policies. The engineering department specifies the machinery, equipment and tools, and determines the processes, operations and materials to be used in producing a product which will comply with the dictates of management in regard to quality and cost. The engineering department also considers the probability of error, based upon the human element and the machine, and in this way determines the inspection necessary to uphold the standard of quality desired.

The effects of lowered quality of the product on a company's sales, profits and good-will are too obvious to recount. The fact that the best machinery, equipment, tools, labor, etc., are being used does not eliminate the need for inspection and, therefore, the great importance of the work of inspection can be easily appreciated.

For example, in a large metal-cutting plant, better selection of workmen, increased wages, and incentives were tried as a means of eliminating high-priced inspectors. The plan was tried for three months and at the end of that period a new corps of inspectors was employed.

The cost of the experiment, i.e., the loss through defective finished products, additional wages paid, and in the excessive amount of sales returns, together with the cost of reemploying new inspectors, amounted to over \$100,000.

**Function of Inspection.**—The function of the inspection department may be very concisely set forth in the statement that the function consists of maintaining the quality standards

of the product set up by the engineering department. This means that after the engineering department has set up standards of quality for the product and determined the points, the kind, and the amount of inspection to be made in order that defects and errors may be detected, the trained inspector has the task of inspecting the material, part, piece, or assembly, to prevent material or parts which do not comply with the specifications from entering productive operations.

**Organization of the Inspection Department.**—So that the function of inspection may be properly administered, attention must be given to the organization of the inspection department. In many businesses, inspection is a major activity and is organized as a department under a separate head, reporting directly to the executive in charge of manufacturing. In the modern manufacturing plant, inspection is almost always of sufficient importance to warrant centralization of that function. The plan of decentralizing the function to the extent of placing working floor inspectors under the complete control of operating foremen is usually not satisfactory. The primary reason for failure of this plan is that foremen frequently exert pressure upon the inspector as a means of covering up their own errors.

Inasmuch as the engineering department sets up the manufacturing specifications, designs, and selects the machinery and other equipment, it is not regarded as a desirable practice to place the inspection department under the control of the engineering department. Otherwise, errors in design or dimension might be hidden deliberately, or the blame placed upon an innocent party, usually a workman. Errors in operation may be covered up if the chief inspector is made responsible to the operating superintendent.

A chief inspector should be placed in charge of the inspection activity in a plant. He must have considerable ability to direct and control the work of the inspection department properly, and must not only know the processes, operations, and assemblies through which the parts must pass, but must know also the purpose, use, and place of each part in the

assembly. He must have a good working knowledge of standards, both technical and operating, and must be well versed in the use of the various inspection tools. In addition, the chief inspector should know the machinery on which the product is made, as well as the skill and training required of the workmen. He must have executive and analytical ability, particularly since he should take the initiative in determining the reasons for rejections of parts or products.

The chief inspector's organization consists of a corps of inspectors scattered throughout the plant, over whom he exercises control. The individual inspectors must have a thorough practical knowledge of the parts and products which they are inspecting so that no part or product which is not within the specified limits may be passed. This also implies an accurate knowledge of the specifications as well as thorough familiarity with the inspection tools.

The character of the products to be manufactured will likely determine whether or not inspection should take place in the various operating and assembly departments or in a central inspection cage. There should be established also an inspection committee, composed of the executive in charge of manufacturing as chairman, the chief inspector, chief of research, chief engineer, and plant superintendent. This committee is responsible for coordinating all activities represented by the members of the committee and determining such policies which will be of mutual aid to all activities concerned.

The operation of such a committee will bring about a clearer understanding of the difficulties involved in quality control and will aid materially in determining causes for variations in materials, parts, and products.

**Classes of Inspection.**—The work of inspection may be divided into the following classes: (a) inspection of raw materials or purchased parts; (b) inspection of processed parts and assemblies; (c) inspection of finished products; (d) inspection of products returned by customers; (e) inspection of new tools, whether purchased or manufactured, and (f) used tools. It would seem unnecessary to inspect raw materials



which have been purchased on the basis of engineering specifications. However, in most concerns this inspection is looked upon favorably in order to preclude the possibility of interrupted production because the proper raw materials are not on hand when needed. This is a costly proposition and one or two temporary shutdowns due to lack of proper raw material, or putting materials which are not up to standard through one or two processes, may more than offset the cost of raw material inspection.

**Methods of Inspection.**—In general, there are two methods of inspecting raw materials, purchased or processed parts, and assemblies. One method is the 100% or critical method. This method requires that each part or product be inspected individually and is, of course, the most costly method of inspection. It usually requires a larger corps of inspectors to prevent congestion or the slowing up of operations or assemblies. This method of inspection is used only when it is essential that each piece be examined, and where the possibility of error is great or a high degree of precision is essential.

The other method, known as the sampling method, requires that at specified intervals, parts or products be taken from the machines or benches, or selected at random from bins or trucks, and measured, compared, or tested. Samples should be taken in correct proportion to volume and in relation to operating time, such as the first two or three pieces produced on an automatic screw machine or punch press, and then other samples at intervals. This should be sufficient to indicate symptomatic variations from standard. In one large automobile tire manufacturing company, every hundredth tire is inspected by examination for visible defects, and about every thousandth tire is given a running test in addition to inspection by examination. The sampling method is much less costly, although it does not insure the high degree of perfection obtained by the critical method. Where the probability of error is low and the faulty part or product would likely be caused by machine setup, or poor material, this method is usually found to be satisfactory. The method of inspection used will de-

pend largely upon the cost of inspection, probability of error, and effect upon quality standards. Some of these factors are subject to accurate determination while others have a more indirect effect and can be measured only in a general way.

**Cost and Precision.**—Referring to the third theory of inspection, precision of limits means increased expenditures and these may increase the cost of production beyond a salable price, but usually precision in large scale production is accomplished by accurate tooling, jigs, special fixtures and rigid maintenance of all equipment and, because of the large volume of production, costs are usually normal. The selection of the correct points in the production layout where inspection should be performed will reduce the cost of both production and inspection.

**Tools of Inspection.**—These are too numerous to mention and very costly to purchase but essential to quality control. It is safe to say that all instruments and measuring devices known to science are utilized in some form of inspection. Chemical analysis will reveal the amounts of the constituent elements present; the microscope reveals external structure, while the X-ray reveals internal structure and the presence of defects; the micrometer is used for determining dimensions; the thermometer records temperature and the stroboscope is used for examining rapidly moving parts. Practically all properties of matter can be measured.

**Inspection Terms.**<sup>1</sup>—**Allowance:** Variation in dimension to allow for different qualities of fit.

**Tolerance:** Allowable variations (in size) equal to the difference between the minimum and maximum limits.

**Limits:** Two sizes expressed by positive dimensions, the larger being termed the maximum, and the smaller the minimum limit.

**Clearance:** A difference in dimensions, or in the shape of the surface, prescribed in order that two surfaces, or parts of surfaces, may be clear of one another.

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<sup>1</sup> Cost and Production Handbook, p. 280.

**Accounting Treatment of Inspection Costs.**—Where the function of inspection is centralized, the cost of the activity is made a direct charge to manufacturing expense, unless it is possible, and does not involve too much work to charge the expense incurred against individual producing departments. For the most part the work of inspection is carried on in the departments where the parts are machined, fabricated, or assembled, and the cost of inspection in each department is charged to an inspection expense account of the department. In many cases certain inspection is considered as a production operation and is included as a part of direct labor. This practice is desirable where all parts are inspected and the inspector's wages are paid on a piece rate basis. In the case of the inspector in the toolroom, his wages are charged to the inspection expense account of the toolroom. Where raw materials or purchased parts are inspected when received in the plant, the cost of such inspection is charged to the inspection account of the stores department. This expense is seldom added to the cost of the materials or parts purchased, although some of the larger concerns have adopted that policy.

In the case of finished products inspected, some disagreement is found. In one concern it is the practice to charge the finished goods inventory with the cost of finished products inspection. In most concerns, however, it appears to be the practice to charge manufacturing expense direct, or to charge the inspection department with this cost. In the case of periodic and other inspection of plant machinery and equipment, made by the maintenance department inspectors, the cost of such inspection is charged to the inspection account in the maintenance department. Regardless of the accounting technique in this matter, the main factor is the determination of accurate costs of inspection by departments where possible, and by class of inspection in the individual plant.

**Handling of Rejected Parts.**—Regardless of the methods used in inspection, the working inspector rejects all parts which do not conform to the specified requirements of the engineering department. The quantity of parts or products

accepted by the inspector is recorded on the time tickets of the workers, and the rejected parts are placed in a bin and tagged. At the end of each day the inspector submits a report to the chief inspector, showing the quantity of parts accepted and quantity rejected. In a number of plants the inspector is required to show on his report the quantity of rejected parts by cause of rejection by departments, if he is working in more than one department or in the central inspection room. This is a very valuable practice, as it materially helps the chief inspector, representatives of the engineering department, and the foremen to cooperate in eliminating unnecessary causes of rejection. In one manufacturing plant, the causes of rejection have been classified under six major heads. Each working inspector is supplied with tags of six different colors, and instructed to attach a tag to each rejected part according to the reason for rejection. This is not a practical plan in many cases, but it is always possible for the inspector to place the rejected parts in different bins or boxes according to the cause of rejection, which facilitates the examination of defective parts by the inspection committee. This examination is made to determine what parts may be salvaged by reworking, and what parts must be scrapped, remelted, or sold as "seconds."

**Analysis of Inspection Costs.**—From the classification of factory accounts shown in Chapter 6, it may be observed that the total cost of inspection can be secured by adding to the cost of operating the inspection department the total of the inspection expense accounts of the individual departments. As a rule, when the total cost of inspection for a period has varied from the standard, an examination of the departmental inspection costs should be made. The total inspection costs might, over a period of years, act as a reasonably accurate basis for the determination of certain percentage ratios which should prove helpful in cost control. For example, a yearly or monthly ratio of total inspection cost to total cost of manufacture might be set up. Again, a ratio of total cost of inspection to total direct labor costs, or number of inspectors to number of direct workers, might be determined. These

ratios, although showing trends only, may induce management to make the necessary analysis to determine the reason and desirability for a given trend.

For example, the ratio of inspectors to direct workers should not fluctuate materially unless the volume of production or the product itself has changed, or a new type of machine or piece equipment has been installed. If a fluctuation is downward and it cannot be accounted for by one of the above reasons, then management should lose no time in making the necessary analysis to determine if a decrease in inspectors is due to a change of engineering specifications, thus reducing the probability of error sufficiently to cause a reduction of the inspecting staff. In addition to changes of engineering specifications, any of the following factors might be responsible also for a decrease in the costs of inspection: (a) changed quality standards; (b) more expensive or different quality materials being used; (c) better quality of labor; (d) better trained labor; (e) more competent supervision; (f) more effective planning of work; (g) more equitable adjustment of individual standards of output; or (h) more efficient working inspectors. On the other hand, if the number of inspectors has increased in relation to the number of productive workers, a similar analysis would be made to ascertain the cause of the increase. Causes of fluctuations in the cost of inspection in proportion to the cost of manufacture or total cost of direct labor might be more difficult to find, because piece rates, increases in wages, sickness, vacation, etc., would enter into consideration.

Many of these contributing factors cannot be accurately measured; at least, it is not practical to measure them. Other inspection ratios can be developed which should be of some value to the management.

**Inspection of Sales Returns.**—Each product returned by a customer should be inspected when received at the plant, and the defects and condition of the product recorded. Sales returns cost money and probable loss of good-will, therefore, they should be very carefully examined. The examination of sales returns forms a significant point of interest where the

cooperation of the inspection, engineering, and sales functions is essential. Sales returns, because of defects in the product, should be examined carefully by the chief inspector and the engineering department to determine the reasons for the defect. If the defects are such that they should have been detected by the inspectors of that product, the supervision of inspection should be checked. If the defect could have been caught by using a different method of inspection, the inspection committee should determine if the amount of sales returns from this cause is sufficient to warrant the use of additional inspectors to check this part or operation more closely. It may be that the point of inspection can be changed to reduce the volume of returns without increasing the inspection cost, or that engineering changes can be made which will correct the defect. The cost of inspecting sales returns is not likely to fluctuate greatly, but the causes of returns should be always carefully examined and analyzed. Cooperation between the manufacturing, inspection, and engineering departments should eliminate sales returns due to defects in the manufacture of the product.

**Final Product Test.**—In those industries where a test must be made of the product after final assembly, it is desirable accounting practice to charge the cost of this work as a direct operation on the product. Where such a test reveals defects in the finished product, the additional work required to bring the finished product up to the quality standard is regarded as a charge against manufacturing expense. The cost of reworking this product to bring it up to the finished goods standard should be kept in a separate account. The inspection report covering the final test of finished goods should be examined carefully at this stage in conjunction with the account reflecting the cost of reworking the product. Such an examination should not furnish the basis for correcting the trouble, and consequently, a reduction of the cost of reworking the product.

**Analyzing the Cost of Reworking Products.**—From the practical operating standpoint it is not usually possible to

eliminate all causes of defects in the finished product, and in view of this it is desirable to analyze thoroughly the cost of reworking the finished product in order to set up a ratio of defects to total units of output, and also to determine a ratio of the cost of reclaiming defects to the cost of total output.

These ratios will be of value to the production control department in scheduling new production, and to the cost department in estimating special jobs or future costs. This information is also of value to the engineering department when considering possibilities of change of design, change of operation, process, material, amount of inspection, tools, machines, etc., in an effort to reduce or eliminate defects in finished goods. An analysis of the cost of reworking the product may enable the inspection department to find the difficulties before the entire product is completely manufactured. If the workmen are to any extent responsible for the defects, it would offer the supervisor a basis for applying corrective measures. In a machine manufacturing concern, such an analysis was the basis for the purchase of new machinery designed to reduce the amount of rejected finished products. In this case, the defects were caused by the poor performance of one machine, which was not easily detected until final inspection of the finished product.

**Departmental Inspection Expense Account.**—In preceding pages of this chapter it was mentioned that where the product inspection took place in an operating department, the cost of such inspection was charged to an inspection expense account of that department. Also, that such costs of central inspection as could be allocated directly to a particular operating department were charged to that departmental inspection expense account. A few of the more important causes of fluctuations in the departmental expense account are:

1. Changes in inspectors' wages.
2. Fluctuations in productive output of the department.
3. Changes in quality standards of product.
4. Engineering changes in design, operation, machinery, equipment, etc.

5. Changes in method, amount, or types of inspection.
6. Changes in wage payment plan of direct labor.
7. Poor supervision on the part of the foremen.

#### **Wages as a Cause of Fluctuation in Inspection Expense.**

—Inspectors in a department are generally paid on a day rate or piece rate basis, depending upon the character of the product inspected and the method of inspection used. If the day rate basis is used, wages will fluctuate only when wages are increased or overtime work is performed. If the piece rate plan is used, costs should fluctuate only in direct ratio to output in the department, unless additional rates are paid for overtime. Caution is necessary in selecting the piece rate plan as the basis for payment of inspectors. The greater efficiency obtained may be more than offset by lack of thoroughness in inspection, which will show up later in the manufacture of the product or in final inspection.

**Fluctuations in Output of the Department.**—Inspection expense in the department may vary because of changes in the amount of its production. Additional inspectors may be required, or fewer inspectors may be needed.

**Changes in Quality Standards.**—More skilled inspection, different methods of inspecting, more inspectors, or less inspection, may be required due to changes in the standards of quality of the product. Changes in standards of quality may be a sufficient cause to attract attention to an increase in the cost of inspection within a department.

**Engineering Changes in Design.**—The engineering department, as a rule, is less interested in the cost of the product than in perfecting the product and the method of producing it. If changes in design of product, processes of manufacture, etc., bring about increased inspection costs, the analysis should reveal a comparable decrease in some other cost element, or should disclose a measurable advantage equivalent to the amount of increase.



**Changes in Method, Amount, or Type of Inspection.—**

In an endeavor to secure a greater percentage of acceptable parts, the method, kind, or amount of inspection may be changed. The specific reason for the change may be to improve the quality or accuracy of the inspection or to prevent defective parts from passing to subsequent operations.

Where inspection work formerly performed in various operating departments is now performed in the central inspection cage, the cost of the inspection may vary. The fluctuation may be due to the fact that in the central inspection cage, where constant and expert supervision exists, a less skilled inspector may be used at lower wages. Before such a change can be made, the savings as a result of centralized inspection should be compared to the added cost of material handling in transporting the parts from the producing departments to the central inspection cage and out again to the next point of operation. If the cost of inspection proves to be greater in the central cage, the added floor space and lack of congestion in the shop may warrant the added cost. Every safeguard must be provided to protect the quality of the product, and when inspection costs change, this should be a danger signal to the management.

**Executive Attitude Toward Inspection.—**Some executives do not have a true appreciation of the importance of inspection and consequently are always on the alert to reduce the cost of inspection at every opportunity, without a careful consideration of the possible effects. Costs of inspection can and should be controlled. Periodic analysis of inspection costs which are fluctuating excessively will not only give the executive the answer as to why they are fluctuating, but will suggest, for his consideration, many indirect factors which may influence the cost of inspection and have a direct bearing on the quality and quantity of output.

Mr. Fisher, president of the Cadillac Motor Car Company, in an article in "Manufacturing Industries" some years ago, stated that of the 7,000 employees in that factory, one out of every 16 is active in inspection tasks. He says further that

in 36,000 operations the limits of variations permissible are 0.001 inches, and on about 800 operations such vigilance is used that only a variation of 0.0005 inches is permitted.

**Testing as a Phase of Inspection.**—Another phase of inspection is the testing of raw materials, purchased parts, sub-assemblies, and finished products. In some industries the subject of testing is of considerable importance. Much time and labor are consumed in testing; expensive machinery and equipment are required, and much raw, processed, and finished materials are destroyed. The purpose of this testing from the raw material to the finished product is to ascertain if the materials used are of the right hardness, strength, quality, elasticity, dimensions, etc.

**Testing Processed Parts.**—Processed parts are tested to determine hardness, softness, durability, wearing points, and strength. For example, processed parts used in the manufacture of a well-known calculating machine go through a case-hardening process, after which a number of parts are tested. The testing consists of breaking a part to determine its tensile strength and a microscopic examination to determine the penetration of carbon. Each of these processed parts is, in addition, given a Rochwell test for hardness. Finished products are tested to determine durability, workability, strength, and general quality.

**Accounting for Testing Expense.**—Testing is expensive, and the extent to which it is carried in most companies makes it necessary to control the cost of this work. The importance of the subject in the average metal-cutting industry warrants special accounting for testing expense. In some plants it is the practice to charge all testing expense to the departmental experimental expense account. In other factories the charge is made against the engineering experimental expense or development account. Where practical, it seems desirable to charge the costs of testing as a direct operation on the product. For example, in the testing of electric motors the cost is charged to the product as an additional operation. The same practice is

true in the testing of automobiles after final assembly. Where the test destroys the part or product, it is desirable to charge it to the testing expense account. The testing expense account should show but slight fluctuations from period to period under normal operating conditions. If quality, quantity, materials, specifications, or wages of testing labor change, the testing expense account should show corresponding changes.

**Need for Analysis of Testing Expense.**—Important changes may take place within the account and not be perceptible in the account total. The account must be analyzed to find out if internal changes have taken place which compensate each other. The analysis of the testing account will, in general, show fluctuations of a similar character to those shown by the analysis of the inspection account, and for the most part will show the causes to be the same.

**Statistical Data for Inspection Control.**—Managerial control of inspection and testing cannot be completely effected through the analysis of the cost of inspecting and testing. Certain statistical data must be collected and analyzed in conjunction with the cost data in order to show the desirability or necessity of inspection in relation to the cost, and also the extent to which inspection should be carried as a matter of managerial policy. For instance, the minimum amount of inspection necessary may not be the desirable amount of inspection. The analysis of the cost and statistical data concerning inspection may show the wisdom of additional inspection in order to build up a better reputation, minimize complaints, reduce the cost of free repairs on the product, and the cost of rendering field service.

**Value of Field Service Reports.**—A certain well-known concern maintained a field service staff for three years before discovering that slight changes in the manufacture of the product and testing at an assembly point would reduce the number of improperly assembled products to such an extent that the field service staff could be substantially reduced, thus saving in salaries and expenses much more than the cost of the changes

made, and at the same time giving a more satisfactory product to the customer. This information was developed through the analysis of inspection costs in conjunction with an analysis of the work reports of the field service staff. In some organizations, field service is under the sales department instead of the more usual practice of having this division under the engineering function. In these exceptional cases the reports of the field service staff are filed in the sales department and care should be taken that they are made available to the engineering and inspection departments, so they may be analyzed and the reasons for rendering field service determined. Much helpful information for engineering, manufacturing, and inspection may be obtained in this manner.

**Inspector's Report.**—One important report from which statistical information of considerable value may be obtained is the individual inspector's report. This report should be made out daily by the departmental inspector and submitted to the chief inspector. The chief inspector consolidates the reports from all departmental inspectors with the reports of inspection in the central inspection cage, and submits a daily report of all inspection to the factory manager.

The use made of inspection reports in one progressive manufacturing concern is explained, since it appears to be a very practical and efficient manner of utilizing these data. The departmental inspectors submit daily inspection reports to the chief inspector, and reports are made up for him of the central inspection cage. He submits to the factory manager a daily inspection report covering the total number of rejected parts, classified according to causes of rejection. The factory manager accumulates these reports for a week and then calls a meeting of the inspection committee. At this meeting the factory manager submits the chief inspector's report, together with specimens of defective parts, bearing individual tags showing the various causes for rejection. When the specimens are examined by the committee and the causes of rejection verified, a general discussion follows as to ways and means of eliminating the causes or reducing the number of rejections



of rejection. The use of this form requires that inspectors be instructed as to causes of rejections, and thoroughly understand the various causes and the particular class under which each cause should be placed. A remarks column is provided in which the inspector may make note of unusual cases or suggestions which he thinks appropriate. The inspector should be urged to make comments on the work which he inspects, and the chief inspector should regard this information as confidential in order that bad feeling may not be developed between the inspector and worker, or between the supervisor and members of the engineering department, or inspection staff.

**Disposal of Rejections.**—In some manufacturing establishments which operate under a piece rate system the workers are required to make good their own defective workmanship and are held responsible for accepting defective work from the previous worker. This method is usually undesirable because it forces a worker to try and repair defective parts received from another operator; also it is impracticable on continuous assembly lines. The more usual method of payment is to pay operators for work accepted by the inspector and no payment for defects.

After rejected parts have been passed upon by the inspection committee they should be sent to a reclamation department, where they are examined and placed in one of three classifications:

1. Scrap—to be placed on scrap pile and sold as scrap.
2. Reclaim—
  - (a) Disassemble, good parts turned back to stores.
  - (b) Additional operations to be performed to recover the part or parts.
3. Seconds—to be sold “as is,” without recourse from the buyer; or to be sold in job lots and marked as “seconds.”

The cost of operating a reclamation unit under certain circumstances is justified and in many concerns a unit of this nature pays for itself in a short period of time. However, it is essential to procure accurate costs of performing this

class of work and then to analyze them in relation with the income received from the unit's operations.

**The Conservative Policy.**—While inspection is of major importance it does not justify the management in accepting without question excessive costs of inspection. Neither does it promote economy in operations to permit the technical operating staff to have a free hand in maintaining quality without regard to cost. It is not likely that management, knowing its limitations and dependence upon technical advice, will overstep its limits. A policy of interest to the extent of asking questions and verifying facts, as well as developing the truth about inspection, its cost and its value, seems a conservative and well-advised policy for the management to follow.

## CHAPTER 20

### CONTROL OF TOOL COSTS

**Tool Definition.**—In the manufacturing industry a *tool* is defined as any implement utilized in performing work of any nature.

**Importance of Tools in Manufacturing.**—The regard in which the toolroom is held is not comparable to its importance in a manufacturing plant. Not only the quality of the production, but sometimes the quantity as well is in part determined by the tools used. The time required to manufacture the finished product and a large element of the cost of manufacturing may be affected by the tools used. Even though the best materials and machines are available, if the tools are unsuited for the work to be performed, if they are in a state of poor repair, or not available, the quality of the product will suffer and the cost of the output will be increased. It can be seen, therefore, that careful selection of tools, proper maintenance, and an adequate system of tool control are requisite to economical plant operation.

**Responsibility for Selection of Tools.**—The engineering department is responsible for the design of the product, the selection of machinery and equipment to be used in manufacturing, as well as the operations and processes through which the product must pass. It seems logical, in view of this, that it should be responsible for the selection and design of the particular tools to be used in producing a specified quality of work.

It follows that the engineering department should be responsible for the proper maintenance and upkeep of tools; that is, a functional responsibility over the tooling department. The engineering specifications for tools required on each job are sent to the tooling department foreman by way of the produc-



tion control department. The production control department acts as a follow-up on the tooling department foreman when special tools for production are being manufactured, in order that they are produced, tested, tried out, and available at the time needed.

**Value of Trying Out Tooling.**—The plan of testing and trying out new tools before putting them into productive use is important. It means that the engineering department can observe the effectiveness and desirability of the tool from an engineering standpoint; the time study man can observe its possible effects on rates or standards for the man or machine where the tool is used; and also, if necessary, the training department can observe its tryout from the standpoint of training and instructions needed for its use. Furthermore, the plan is of value to the production control department in scheduling production orders.

**New Tool Record.**<sup>1</sup>—A careful record should be made of each tool that is on trial in the factory. This record should show the following information:

1. Name and description of the tool.
2. Manufacturer's name.
3. Cost of tool per unit.
4. What accessories are necessary and their cost.
5. What tool now in use is it to replace.
6. What will the advantages be:
  - (a) Increase production.
  - (b) Decrease tool cost.
7. Are there any features that are not in accordance with "safety first" principles?
8. What are the estimated savings effected:
  - (a) Show cost under present method.
  - (b) Show estimated future cost.
  - (c) Show the quantity of material manufactured yearly that this tool will be used on.

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<sup>1</sup> Cost and Production Handbook, p. 842.

**Managerial Problems in the Toolroom.**—The toolroom or tooling department is often referred to as the heart of the shop. It presents many difficult problems to management. The determination of the character, quality, and quantity of tools needed in production, although primarily an engineering problem, vitally concerns the management. The problem of tool cost is also a dominant factor in determining the type and quality of tooling necessary. For instance, management must know definitely the number of pieces a tool is capable of producing to pay for itself in a given time. The amount of money which should be spent for a tool to turn out a given number of parts. How long it will take for a tool to show a saving on a given production. The savings in dollars and cents of one class of tool over another class of tool, and many other problems of this nature must be solved by management. Consideration must be given to the question of what tools should be purchased from outside vendors, and the extent to which tool manufacture should be carried on within the plant. Tool manufacture within the plant means investment and expenditure, and sometimes the cost of making tools is excessive. Whether purchased outside or manufactured within the plant, the number of tools required for manufacturing the product represents a considerable investment in money. Therefore, it is desirable to plan tool use most carefully and study tool activity closely in order to keep the investment as low as possible and consistent with tool requirements. This study may also be of assistance in the control of the experimental tool account.

**Toolroom Personnel.**—The problem of labor and supervision in the toolroom is a difficult one. Expert toolmakers are needed for the manufacture of tools, and this means high wage cost. The fact that toolroom labor is usually on a day rate basis makes it easy for the cost of labor in the tooling department to increase without apparent reason. The quality of supervision required to operate a tooling department properly is very high. Not only must the foreman or supervisor be a skilled mechanic, but he must have the ability to direct the

work of the men under him and so plan their work that there will be no idleness or loafing on the job. The accuracy required in manufacturing tools means that great care must be taken by the supervisor to see that specifications are followed. It is never good economy to employ a low-priced supervisor for the tooling department. The best man available should be secured and a satisfactory wage paid to him. His wages should be regarded as an investment in quality and output of tools. His work in the tooling department can contribute materially to increased production. It is only through his ability to direct and control the work of the department that proper tools can be produced.

**Organization of the Tooling Department.**—The tooling department may be divided into: (1) Tool Manufacturing Division; (2) Tool Maintenance and Inspection Division; and (3) Tool Storage and Issue Division.

**THE TOOL MANUFACTURING DIVISION.** This division is under the direct supervision of a foreman, usually an engineer or expert mechanic. He receives specifications and drawings from the engineering department, and reports to the factory manager regarding discipline, hours of work, and wages. The work of this division consists largely of the manufacture of special tools to be used in production, and the building of experimental tools or machines designed by the engineering department.

**TOOL MAINTENANCE AND INSPECTION DIVISION.** This division is responsible for the maintenance and inspection of all tools which have been used in production and returned to the toolroom.

**TOOL STORAGE AND ISSUE DIVISION.** Good practice in the operation of this division should conform to the following procedure as closely as conditions will permit.

When tools are purchased and received at the plant, they are inspected by a qualified tool inspector. If accepted, they are sent to the tool storage and issue crib, where each tool is marked with the company's identifying classification. If the

quantity of tools purchased is greater than the immediate productive needs, the excess should be stored in the reserve supply room.

**Tool Crib Operation.**—When tools for active use are placed in the crib, the tool clerk makes a record of their receipt on his inventory card, showing the date, quantity, description of tools received, and the purchase order number. The tools are now ready for issue to the shop. Where the production control system is highly developed, tool requisitions are prepared by the production control unit, instructing the toolroom clerk to assemble certain tools for a specific production order, and either to hold them until requisitions are received from the foreman of the departments requiring these tools, or to send them to specified departments at stated times. The toolroom clerk is responsible for the tools in the crib, and must issue the tools only on authorized requisitions.

**Methods of Tool Issue.**—The methods of issuing tools differ widely in practice. Many concerns use a very simple system consisting of brass checks issued to the workmen and, for record purposes, charged to them at a nominal price. When the workman wants a tool he goes to the toolroom, presents a brass check bearing his payroll number, and receives the tool. The check is hung on a peg alongside the bin, while one of the brass checks on the peg at the bin bearing the tool number or name is hung on the tool control board under the workman's number.

This system, although simple, is effective. If the workman loses his checks or his tools it is difficult to straighten out the matter without friction. A better system, although not in general use, is to require the signature of the foreman and worker upon a written requisition (prepared in triplicate) specifying the tools needed. This requisition (see Figure 32) is presented to the tool clerk, who issues the tools called for. The workman retains the triplicate copy of the requisition. The duplicate copy is filed at the bin, according to the workman's name or number and the original copy is filed according to the tool code at the desk of the issue clerk.

When a tool has been used and is returned to the tool crib, the records at the bin and issue desk are removed. The information on the original requisition is completed by noting thereon the time the tool was returned and its general condition. It is then placed in a different file until withdrawn for

Form No. _____		<b>THE M. G. MANUFACTURING CO.</b>		Original	
<b>TOOL REQUISITION</b>					
Date _____		Production Order No. _____			
		Expense No. _____			
To the Tooling Department Foreman:					
Please deliver the following tools to _____ Department					
Quantity	Tool Symbol	Size	Description of Tools		
Signed _____			Signed _____		
Workman			Foreman		
Tool Department					
Date Returned _____			Repairs Necessary _____		
Number of Pieces Produced _____			Cost of Repairs _____		
Inspector's Remarks _____					

Figure 32. Tool Requisition

analysis. The returned tools are sent to the toolroom for detailed inspection. If no repairs are needed, the tool is returned to the crib for reissue. However, if repairs are needed, the tool is put into the repair bin, from which it is sent to the tool repair division for the necessary work. A record should be kept of each tool sent to the tool repair division, unless it is the practice to exchange a tool needing repairs for a reconditioned tool.

**Handling of Broken Tools.**—It should be an invariable shop rule that all tools issued to workmen must be returned to the crib regardless of their condition, so that the workmen may receive proper credit and the tool may be inspected to determine whether or not it can be repaired or salvaged. An ex-

amination of broken tools often reveals defects in manufacture, incorrect use, poor repair, etc. It should be a strict rule in the factory that no employee be permitted to make repairs on a tool, particularly resharpener or grinding. This work should be performed by a skilled tooling man; (a) if the tool is to give the most economical service; (b) if the standards of quality of finished products are to be maintained; and (c) if the standards of individual output are to prevail.

**Advantages of the Written Requisition System.**—The written requisition system may be used where centralized or decentralized storage and issue of tools are practiced. The attendant of the subtool crib located in a department follows the same procedure as in the central tool crib. The use of this system may involve slightly more time and perhaps a little more clerical cost but, as a general practice, its advantages in preventing disputes and withdrawal of tools by presenting found tool checks more than offsets the added cost. In addition, this system has the advantage of providing a written record of each tool withdrawn, number of times used, the length of time in service, and space for remarks concerning condition and repairs. This plan enables the tool clerk to locate at once any tool in use. Furthermore, it provides basic information required in making a statistical study of the use of tools, their life, and performance.

**Analyzing Tool Use.**—By analyzing tool use, it is often possible to reduce tool investment greatly, and hold the quantity and type of tools to the preplanned shop requirements. The analysis may reveal that the needed tools are not available, or that unsatisfactory makeshifts are being used. It may further show that small quantities of tools are being purchased at retail prices in order to hold down the inventory of tooling. In a small automobile manufacturing company, the tool inventory represented an investment of \$500,000. An analytical study of tool turnover was undertaken, with the result that the tool investment was reduced 50%. Such a reduction is possible only where accurate written records of tool issue and use are kept.

If it is the managerial policy to charge the workman with the cost of tools not returned to stores, the written control system serves as a basis for making the charge. Misplacement of tools, deliberate and otherwise, costs the average manufacturing company a considerable sum of money annually. This loss may be prevented by installing an adequate system of tool control, supplemented by a careful analysis of tool costs. The control system will help also in many other ways to reduce tool costs, as will be pointed out in the analysis which follows.

**Tooling Department Cost Accounts.**—From the classification shown in Chapter 6, the accounts have been selected which are believed to be representative for the accumulation and analysis of tooling department costs:

- Superintendence
- Technical Assistants
- Inspection
- Clerks
- Storeskeepers and Assistants
- Janitors and Sweepers
- Maintenance of Machinery
- Maintenance of Motors and Controllers
- Maintenance Dies
- Maintenance of Jigs and Fixtures
- Maintenance of Gauges
- Maintenance of Other Tools
- Maintenance of Furnaces
- Perishable Small Tools
- Supplies
- Lubricants and Cutting Oils
- Office Supplies
- Steam
- Electricity
- Gas
- Experimental Expense
- Fixed charges, including rent, taxes, depreciation, and insurance

This list of accounts does not presume to be all-inclusive. In many plants a more detailed setup will be found. In most cases these accounts will provide the information needed in controlling tooling department operations. In some plants, such accounts as sickness, absences, military service, fire protection, building maintenance, etc., may be included.

Some of these accounts do not fluctuate materially within a cost period, and where fluctuations do occur, the causes can be readily ascertained by observation of the accounts. It is understood that accounts not specifically mentioned in the following paragraphs must be analyzed when fluctuations occur.

**Maintenance of Dies.**—The maintenance of dies account may be misleading in its terminology. It includes not so much the usual type of maintenance work as it does the regrinding of dies and replacement of parts within the die. It may be that where very large dies are in use, separate accounts will be found desirable for each die because of their high cost. Although the information needed may be secured in this way, it seems a more desirable practice to use a standing shop order on which maintenance costs for each die are accumulated. The costs accumulated on the standing orders are transferred to the maintenance account monthly.

In one manufacturing plant having over five million dollars' worth of sales annually, the cost of die maintenance averages more than forty thousand dollars yearly. This shows clearly the necessity for keeping this account under constant supervision to prevent the costs of die maintenance from becoming excessive. It must be remembered that the regrinding of dies greatly reduces their total productivity. In order that analysis of this account may be of value, the cost data must be supplemented by certain statistical data which will indicate the performance of the dies, the economical run, and their life expectancy.

**Fluctuations in Die Maintenance.**—When the cost of die maintenance fluctuates, it may be traced either to repairs made on the die or to regrinding. If the fluctuation is due to repairs, the same elements of material and labor that have been con-



sidered previously in other maintenance analyses should be examined. If the change is due to replacement of parts, the part replaced should be examined to determine defects or possible new methods of construction to prevent wear and tear on this particular part. If the fluctuation is due to regrinding the dies, not only should the cost of labor and material used in regrinding be examined, but the cost of regrinding in relation to the cost of the die, and also in relation to its performance and life expectancy should be studied.

This will probably lead to the question of economical run of a die, which involves estimates of productivity of the die between regrindings; investment in surplus parts, adherence to the production schedule, cost of regrinding, delays in production, necessity for additional dies to prevent delays, and machine setup time.

**A Die Maintenance Problem.**—A power press die was manufactured at a cost of \$3,750 in a certain metal-cutting plant. The engineer estimated that the die was capable of producing 1,500,000 parts total. He further estimated that the die would produce 30,000 parts before regrinding was necessary. The production schedule called for the production of 25,000 parts on this operation. The question then arose as to whether the most economical procedure would be to keep the die set up until it had produced the initial run of 30,000 parts, at which time it would require regrinding. This plan would necessitate the storing of 5,000 surplus parts for two or three months until required by the succeeding production schedule. The alternative was to knock down the die after the production schedule of 25,000 parts had been reached, and grind it so that it would be ready for another run of approximately the same number of parts.

There are many facts to be considered. When 30,000 parts were produced, the die had been utilized to its full capacity without regrinding. However, there remained 5,000 surplus parts to be stored for a period of months, requiring additional storage space, tying up a certain amount of money, and producing, possibly, a slight increase in fixed charges.

On the other hand, the production schedule calls for only 25,000 parts, which if adhered to, would mean taking the die out in order to use the press for other work, whether or not the die was reground.

Had the decision been to reground the die after 25,000 parts had been produced in order to facilitate production when a similar number of these parts would be needed again, it would have meant a loss of productivity of the die amounting to 5,000 parts, or  $16\frac{1}{2}\%$  of the first run of the die, and a percentage loss of the total life of the die. In case the die had been removed from the press but not reground at the end of the scheduled production of 25,000 parts, it would have been necessary to place the die in storage until again required for production. At this time a new setup would have been required for the production of 5,000 parts, at the completion of which the die must be reground.

**Value of Knowing the Economic Run of a Die.**—Solving the problem of the economical run of a die may greatly assist in determining the number of dies that will be required. In the above mentioned factory it led to reduction in number of these dies from 5 to 3, with a consequent reduction in investment of some \$7,000. When it is considered that a large number of similar dies is required in the average metal-cutting plant, the amount of savings which can be effected through determination of the economical run is appreciable. The solution of this problem can be reached through careful engineering estimates of die construction costs and performance and the use of statistical and cost records of past and present die productivity.

The production control department should give careful consideration to the economical run of a die in planning for the production of various parts and products.

A secondary cause of fluctuations in cost of maintenance of dies may be traced to improper handling of the die, poor storage, incorrect speed of press, and use of improper materials in the operations.

**Maintenance of Jigs, Fixtures, Drills, Gauges, and Other Tools.**—The great variety of tools used in the average manufacturing plant makes it impossible, in the scope of this chapter, to discuss each class of tool separately. A discussion of the classes of tools stated above will, in general, indicate the method to be followed in the analysis of tooling costs for other classes of tools not specifically mentioned herein.

Fixtures are tools attached to the table of the machine, and serve to locate and hold the work in the proper position. Jigs are similar to fixtures, except that they are free to move, and serve to guide the cutting tool. Jigs and fixtures are essential to mass production and assist in securing a high degree of accuracy in manufacturing, with a minimum expenditure of time in measuring and marking parts for machining operations. These tools are expensive and must be properly cared for. The cost of their maintenance should be very low, provided they are given proper care and use. No specific causes of high maintenance costs for these tools can be given, except normal wear and tear, or abuse.

**Drill Maintenance.**—Drills are one of the most important and expensive classes of tools used in manufacturing. As a rule, small and inexpensive drills are classified as "perishable small tools," while larger and more costly drills are capitalized and depreciated in the same manner as other expensive equipment. The initial cost of drills is an important element in the cost of manufacturing, and the cost of their maintenance may amount to a considerable sum. Furthermore, delays and hold-ups in production, amount of spoiled product, and loss of time of operator, caused by faulty maintenance of drills, tends to increase production costs.

The cause of high drill maintenance costs is usually due to incorrect grinding, or using the wrong type of drill for the particular work. In some instances, the cost of maintaining drills is increased by the practice of charging the cost of replacements to the tool maintenance account. Where this is the policy, care must be exercised to separate actual maintenance costs from the cost of replaced drills. This separation

will assist the management in making a more detailed study of the cost of labor and materials used in maintaining drills, and permit them to inquire into the cause of broken drills charged to maintenance.

Many causes for regrinding or breaking of drills exist which an analysis will not show. Several of these causes, their symptoms, and suggested remedies are concisely stated in Figure 33 which has been taken from the Cleveland Twist Drill Company's handbook for drillers.

**Gauge Maintenance.**—Gauges are measuring devices, such as micrometers, verniers, snap gauges, etc. They are used chiefly by workmen and inspectors to check up work as it is machined. If the workman does not stop his machine when gauging the cut or dimension, even though the gauge is made of hard steel, undue wear will result and may quickly render the gauge worthless. Proper instruction and supervision should prevent this costly practice. Where workmen are on piece rate pay, the practice is difficult to prevent, since they desire to conserve time in order to obtain the greatest production. Gauges are not charged to the workman, and they are usually not concerned in conserving them.

The gauge maintenance account should be analyzed to determine: (1) the nature and extent of variations; (2) their causes; (3) the possible other effects of these causes on production. If the cost of gauge maintenance decreases, it may be the result of unwise economy.

Poor tools mean poor product and smaller output. If too much pressure is brought to bear on the toolroom to keep down maintenance costs, it may result in poor repair or poor upkeep. This may bring about increased spoilage of materials, reduced output and dissatisfaction on the part of the workman because standards cannot be made.

**Contributory Causes of High Tool Maintenance Costs.**—Analysis of the tool maintenance account will not reveal such contributory causes as: (1) excessive speed of the machine which may cause fracturing, chipping, or burning of the tool; (2) the use of improper tools; (3) carelessness of workmen

<b>A First Aid For Drill Press Operators</b>		
SYMPTOMS	PROBABLE CAUSE	REMEDY
BREAKING of drill.	Spring or back lash in press or work. Too little lip clearance. Too low speed in proportion to the feed. Dull drill.	Test press and work for rigidity and alignment. Regrind properly. Increase speed or decrease feed. Sharpen drill.
BREAKING down of outer corners of cutting edges.	Material being drilled has hard spots, scale or sand inclusions. Too much speed. Improper cutting compound. No lubricant at point of drill.	Reduce speed. Use proper cutting compound and correct application.
BREAKING of drill when drilling brass or wood.	Chips clog up flutes.	Increase speed. Use drills designed for these materials.
BROKEN TANG.	Imperfect fit of taper shank in the socket—due to nicks, dirt, burrs or worn out socket.	Get a new socket or ream old one to prevent recurrence.
CHIPPING of margin.	Oversize jig bushing.	Use proper size bushing.
CHIPPING of lip or cutting edges.	Too much feed. Too much lip clearance.	Reduce feed—see table on page 28.... Regrind properly.
CHIPPING or checking of a high speed drill.	Heated and cooled too quickly while grinding or while drilling. Too much feed.	Warm slowly before using. Do not throw cold water on hot drill while grinding or drilling. Reduce feed.
CHANGE in character of chips while drilling.	Change in condition of the drill such as chipping of cutting edge, dulling, etc.	Regrind drill properly.
HOLE too large.	Unequal angle or length of the cutting edges—or both. Loose spindle.	Regrind properly. Test spindle for rigidity.
ONLY one lip cutting.	Unequal length or angle of cutting lips or both.	Regrind drill properly.
SPLITTING up center.	Too little lip clearance. Too much feed.	Regrind with proper lip clearance. Reduce feed.
ROUGH HOLE.	Dull or improperly ground drill. Lack of lubricant or wrong lubricant. Improper set-up. Too much feed.	Regrind properly. Lubricate or change lubricant. Reduce feed.

Figure 33. A First Aid for Drill Press Operators  
(The Cleveland Twist Drill Co.)

in the handling or use of tools; (4) defective new tools; (5) improper maintenance of tools; (6) incorrect speeds and feeds of machines; and (7) inadequate storage. In addition to the analysis, management should make a study of tool use, consumption, and turnover by classes. This study will aid in discovering excessive consumption or maintenance in any class of tool and will point the way for a further study of design, method of use, specifications, sources of supply, and purchase costs.

**Tool Inspection Can Aid in Reducing Tool Costs.**—The economic operation of the toolroom may be greatly influenced by the tool inspector. Unless he is a capable man, thoroughly familiar with the manufacture, use, and maintenance of tools, he cannot be of much assistance in reducing and controlling the cost of toolroom operation. If he is not familiar with standard specifications for tool repair and upkeep, he may authorize needless sharpening and grinding of tools. Furthermore, unless he is capable of examining a used tool and determining the cause of defects, he cannot make the necessary recommendations to correct existing conditions, and thereby reduce the cost of tooling.

The tool inspector can be of valuable assistance to the engineering department in making comments and suggestions relating to the design and use of tools. Likewise, he can be of material assistance in reducing the cost of tool maintenance through cooperation with the operating foreman in instructing workmen in the use and care of tools.

**Perishable Small Tools.**—The perishable small tools account is usually regarded as a major expense account which may fluctuate considerably from period to period. It, therefore, should receive the careful attention of the management. Perishable small tools are usually defined for accounting purposes as all those tools which will be consumed within one year. While it is true in practice that many of the tools charged to this expense account have a longer life than one year, the cost of such tools may be small and their use infrequent. The necessity for gradually depreciating those tools which have

been capitalized, and the clerical cost involved in keeping necessary records for this purpose oftentimes warrant the practice of charging certain of them to this account.

In a few manufacturing concerns it has been found expedient to keep small tools in the general storesroom, and the investment tools in the toolroom. In such cases the accounting practice is to keep the small tools on inventory and charge them to requisitioning departments as they are withdrawn.

**Classification Aids in Control of Small Tools.**—The fact that perishable small tools are, as a rule, comparatively inexpensive and are generally called expense tools appears to be the only reason for the lack of definite control over them in most manufacturing concerns. In order that the small tool account may suffer the least abuse, the accounting department should set up a classification which will include a complete list of all small tools, such as is shown on page 105, so that only the proper charges will be made to this account.

Such a procedure will assist materially in making an analysis of the account to determine the causes of fluctuations. It is evident that tools not mentioned in the classification, if charged to this account, will cause unwarranted fluctuation. Only through a detailed analysis of tool requisitions can this cause be located.

**Handling Expense Tools.**—The practice of handling small tools in the tool crib differs generally from the method of handling investment tools. They are placed in the tool crib and issued in small quantities to departments on foremen's requisitions. A foreman usually has a locker or an open tool box in which his supply of expense tools is kept. A workman either goes to the locker or asks the foreman for the tools required and no record is made of their issue. This is an open invitation to waste these expense tools. In many plants the argument is advanced that the cost of making requisitions for each expense tool needed by workmen would be greater in many cases than the cost of the tool. Although it is known that many of these tools are taken out by workmen and mis-

laid, this cost is relatively small compared to the cost of maintaining a system of written requisitions.

The individual plant should make a detailed study of small tool costs and compare them with estimated requirements in order to determine the extent and character of the control methods needed. A visit to the district of second-hand stores of any manufacturing city will provide concrete evidence of what becomes of many small tools. The second-hand dealers are usually well stocked with them, and in more than one instance company initials or inventory symbols have been found on tools which were for sale.

**Fluctuation in Expense Tool Cost.**—Fluctuations in small tool cost should correspond in large part to the changes in shop activity, although the rate of labor turnover and changes in design may have a pronounced effect upon their consumption. If the cost of expense tools is analyzed regularly by departments and compared with the output of the department, a basis may be established for justifying their cost to that department. The foreman should be given reports at stated intervals on the cost of small tools and also be supplied with engineering estimates of small tool consumption at the planned rates of production.

Perhaps the greatest waste of small tools is due to abuse and theft. A workman, knowing the value of a tool and finding it easy to procure a new one, is not inclined to be careful in using the tool. He will seldom use a tool until it is of no further use, but usually at the first sign of wear will throw the tool away and secure a new one. The stamping of a symbol, or the initials of the company on each tool, and educating the workman to the fact that the tool can always be identified may help to reduce theft.

**Experimental Expense.**—This account usually includes the cost of developing experimental tooling and machinery. If the machine or tool developed is found satisfactory and can be used successfully, its cost is capitalized; if it is not, the cost is charged to manufacturing expense or written off to profit and loss.



The very nature of this account makes it a dumping ground for many small items of expense which the toolroom foreman may wish to hide. It also makes it possible for him to carry excessive labor in the toolroom and disguise it through the experimental account. An analysis of this account will reveal little information, except when the material requisitions and labor tickets are thoroughly examined. Assistance of the engineering department may be needed in checking the cost experimental expense.

The monthly total of this account cannot be compared with figures for preceding periods, nor can it be related to any other stable factor such as plant investment, or plant output. Each experimental job is different, and the labor and materials required will vary. The engineering department usually makes estimates beforehand of the cost of an experimental machine or tool. These estimates should be carefully checked with actual costs. It is seldom that they approximate the actuals, but they furnish a comparative basis for checking up actual cost of the particular piece of experimental equipment.

**Possibilities of Reducing Cost.**—The cost of operating the toolroom in the average factory is usually high, and any step which will help to reduce it should be taken. An analysis of the various elements of the cost of operating this department will, as a rule, show ways in which costs may be reduced or kept at a reasonable level. It is certain that the analysis will be of material assistance in the formulation of policies to govern toolroom operations. Furthermore, the check of costs by the management from time to time will have a good effect upon the toolroom and shop personnel. Likewise, the collection of accurate data of toolroom operations will help to introduce beneficial changes.

Information pertaining to tool activity, tool turnover, tool performance, and tool life in relation to output and cost of maintenance is always helpful in writing specifications for tools to be made or purchased, and in determining the desirable amount of money to spend on their maintenance.

## CHAPTER 21

### CONTROL OF MATERIAL HANDLING COSTS

**Definition.**—Material handling is the process of elevating, moving, conveying, or lowering, or a combination thereof, by any means whatsoever, of all types or classes of material for the purpose of changing its place utility. Material handling equipment refers to all devices or mechanisms utilized in handling of materials.

**Importance of Material Handling.**—Increasing recognition of the importance and cost of material handling is well illustrated by the attention industrial executives are giving to the subject in an effort to perfect methods of material handling and to reduce handling costs. The problem of handling materials from receiving platforms, or freight cars into stores, and from there through the production processes and into finished stores or delivery to carriers is an enormous problem. One well-known authority on the subject states that the cost of the finished product is directly proportional to the cost of handling that product.

Mechanical means of handling materials have played a large part in the transition in industry from handling practically all materials by hand, which was the general procedure twenty-five years ago, to present-day methods. In a great many cases, plant construction and layout make the installation of mechanical handling devices too expensive. This can be overcome by better planning of factory buildings. The installation of mechanical handling equipment is not the whole solution. There must be, of course, the justification for mechanical equipment in terms of work to be done, as well as the proper scheduling of the use of the equipment in order to make the amount of handling justify the installation.

The production control department of the modern plant is best qualified to schedule the work and direct the use of the handling equipment so that it will afford the greatest utility.

Proper handling of materials reduces the handling space required which makes possible more room for productive machinery; facilitates production by keeping machines and men busy as far as availability of materials is concerned; reduces spoilage, breakage, damage, and loss of the raw, processed, or finished products; and, in many other ways, helps in cost reduction and waste elimination. Therefore, in viewing the subject of material handling, a broad attitude should be taken and not one that is confined to the immediate and direct costs of handling and transporting materials. The subject should be regarded as one which will materially benefit the plant as a whole in assisting in more economical production, greater smoothness of operation, and increased volume of production, as a result of a continuous flow of materials to and from operations.

**Principles of Material Handling.**—There are five fundamental principles of the economic handling of materials.

1. Economy is procured by handling materials only when absolutely essential.
2. Material should be handled by the shortest economical route.
3. Material handling operations should be performed by whatever means or methods that result in the lowest cost consistent with managerial requirements.
4. The handling of materials does not increase their value but it does increase the cost of the products in which those materials are utilized.
5. The movement of materials must be consistent with and timed to the movement of production and conform with the production schedule.

Few executives realize the amount and weight of material handled each day in their plants or the cost of moving material from one place to another.

It is suggested that some enterprising executive work out the cost per ton per mile or part per thousand feet for his plant and then analyze the possibility of reducing that cost.

**Causes for High Cost of Handling.**—High handling costs are generally indicated where:<sup>1</sup>

1. Unnecessary handling is performed.
2. More than one man is moving material without mechanical assistance.
3. Men are lifting and handling articles weighing over 100 lbs.
4. Men are loading from floor to trucks or from trucks to floor.
5. Machine operators are doing any laborious lifting or any work except putting articles into machine, supervising machinery operations, and removing articles when finished.
6. Materials are moved from container to container.
7. Materials are unnecessarily diverted from receiving platform for clerical records or inspection when they should go directly to machines.
8. Men on assembly floors or elsewhere are waiting for materials.
9. There are delays in delivering from storesroom to operators.
10. Scheduling for delivery is inadequate, causing delays at machines or necessitating extra delivery trips.
11. There is a retrograde movement of materials in process of fabrication.
12. Antiquated apparatus or methods are in use.

**Problems of Material Handling.**—A thorough analysis of the problems of handling materials cannot be taken up in this chapter. It is the purpose in presenting the subject to mention only a few of the major phases of the handling problem, and to develop later other aspects of the problem in addition to treating those elements mentioned herein. The problem

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<sup>1</sup> Cost and Production Handbook, p. 852.

must consider such items as the area to be served; the distance covered in handling; continuous or intermittent delivery; internal or external handling; the floors to which materials are to be delivered and picked up; the plant layout; the availability of space, aisles, yards; the volume of handling; character of materials; speed of handling; mechanical devices available, cost of devices, their special and general uses; supply of labor; cost of labor; plant construction; plant congestion and a great many other elements.

### **Rules for Material Handling.<sup>2</sup>—**

1. Know every kind of material handling equipment on the market.
2. Analyze materials routing carefully.
3. Visualize each job's actual needs.
4. Buy for operating savings, not for first cost.
5. Get together with designers and manufacturers.
6. Lay out equipment when building is planned.
7. Rearrange equipment systematically.
8. Teach operator possibilities of his equipment.
9. Maintain equipment the same as production machinery.

**Scope of Material Handling.**—For the purpose of this chapter the scope of material handling will be limited to all phases of material handling up to and including placing the finished product in the shipping department ready for crating, boxing, or packing.

The question of local deliveries, handling to carriers or to cars, will not be included here but will be discussed in the chapter dealing with the cost of traffic department operations.

**Organization for Material Handling.**—No standard practice is found in organizing for material handling. Individual plants solve the problem in their own way in view of their needs and the importance and character of materials to be handled. In some well-organized plants, material handling consists of all outside handling and internal transportation. A separate department is set up with a foreman in charge. All

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<sup>2</sup> Cost and Production Handbook, p. 853.

movable handling devices are centralized under this foreman's control, as well as all labor used in handling materials and in internal transportation. In one large company the stores department functions under the supervision of material handling.

In many plants material handling equipment and labor are located in the various departments requiring internal transportation, and are under the supervision of the operating foreman of the department. Yard and receiving handling in most of these plants is taken care of by an extra gang or other indirect labor which is recruited from different departments. Likewise, the handling of scrap and frequently the handling and loading of materials and equipment to be transferred to other plants are performed by this gang.

If operating as a centralized function, the material handling division may have a separate head reporting to the production manager. If decentralized, the men and handling equipment are scheduled by the production control division or departmental foreman.

**Operating Economy and Control.**—As a matter of operating economy and effective control of material handling and internal transportation, it seems a sound practice to centralize the function under a separate head reporting directly to the production manager. This would mean that the labor utilized in unloading, yarding, storing, handling into production, handling through processes, assemblies, and departments into finished stores, as well as the movable handling equipment used in this connection, would be controlled by a central head in whom would rest the responsibility for following out the orders of the production control division in moving materials. This central head would also be responsible to the production manager for unloading and storing or yarding all raw materials and supplies.

Where such an organization for material handling is employed, the cost of handling materials will likely decrease. The investment in material handling equipment will be less, for the proper scheduling of the use of the equipment means that it is kept in use constantly, and no more than the amount of

equipment required is purchased. The tie-up between material handling and production control which this plan affords reduces to a minimum production hold-ups due to material not being on hand where and when needed, and also prevents spoilage and damage to materials because of congestion in a department. Less labor is required to perform the handling work and less idle time of this labor results. The handlers may be more easily trained in the operation of the equipment and in the handling of the various materials. Car service, demurrage charges, truck rentals, storage charges, warehousing, or terminal charges are cut down because of the scheduling of the handling work.

**Storeskeeping.**—The subject of storeskeeping is one phase of the major subject of material handling. The activities of the stores section include the storage, issue, and physical accounting for all materials.

It can, therefore, be said in regard to the organization of the storeskeeping section that it should be set up under a separate head as a coordinate function with material handling, directly responsible to the production manager, or should be set up as a subordinate section of material handling, reporting directly to the head of this division. The former plan is more generally found in manufacturing industries although it involves a violation of good organization, because this plan divides the function of material handling. It cannot be stated as a general rule that the latter plan is more desirable than the former, although it does provide many advantages in organization and control. Either plan is superior to the custom in many concerns of having the storeskeeping section directly responsible to the purchasing head.

Management should regard materials as so much money invested. If this is done, then consistency requires that management take the same steps to insure proper handling and accounting for materials as it does for money. No individual in the average organization is permitted to handle money without a most exact accounting, yet there are but few organizations in which those who handle materials are required to give

such an exact accounting for the materials. Furthermore, management would be dissatisfied to see its money lying idle in its vaults or in a bank without receiving interest, yet it gives but little attention to the money lying idle in the form of stored materials.

Management would put forth strenuous efforts to stop the waste or gradual dissipation of its capital in the form of money, but it usually sits idly by without questioning the amazing amount of waste and dissipation of materials which occur in many storesrooms.

**Possibilities of Loss in Storage.**—A brief examination of the activities of the storesroom will show the possibilities of idleness, loss, and waste of materials, as well as other important indirect effects of lack of proper storesroom organization and control. In the work of storing materials considerable waste may exist. If materials are improperly stored, breakage, leakage, bending, as well as corrosion, rotting, warping, or internal combustion may result; old materials that remain at the bottom of the pile are never used, delays in issuing materials occur, physical inventory is made more difficult, insurance rates are higher, and accidents to employees more likely to occur. Furthermore, additional space is required for storing, and misplacement of materials may cause an interruption to production until a new supply of materials can be secured. When the extent of the waste is realized, the question of proper storing assumes an importance which focuses management's attention upon the storesroom organization.

The proper issuing of materials not only includes the passing out of materials from stores on properly authorized requisitions, but it also involves the keeping of accurate records of receipts and issues. To this work in the modern manufacturing plant has been added the task of keeping prices of materials, pricing of requisitions, keeping a balance of stores record, and issuing purchase requisitions when order points have been reached. If the work of issuing materials and all that it involves is not properly organized, cost data will be inaccurate;



inventories, financial reports, and income tax statements will be incorrect.

**Physical Accounting for Materials.**—Physical accounting for materials is important in connection with the work of issue and the financial accounting for materials, making of fire loss adjustments, and for taxation and appraisal purposes. Furthermore, it always brings to light bad conditions in the storesroom, such as oversupply, improper storing, spoiled, damaged, or decayed materials, obsolete stock, and unaccountable shrinkages. The physical amount of materials in stores must be in agreement with the balance as shown by the records of the stores control unit.

**Accounting Procedure for Material Handling and Stores Operations.**—It is regarded as good accounting practice to charge directly to an expense account of each producing department the cost of material handling labor and the cost of maintaining the handling equipment used solely by that department. Where intermittent service is rendered to a department, it is charged with the cost of the service, if practical to do so; otherwise, the service is treated as are the other elements of material handling expense, which cannot be directly charged against specific departments. All such expenses are charged to the material handling department and prorated on a predetermined basis (see page 118) over the departments receiving this service. The cost of operating the storesroom includes the wages of the personnel, the fixed charges, and maintenance of storesroom equipment.

Where stores activities are centralized, the cost of operating the unit is charged against the Storesroom Department account and is prorated on some equitable basis (see page 119) over the productive departments. In case there is a storesroom serving an individual department, its cost is charged directly against that department.

**Physical Inventory.**—Where a perpetual physical inventory is made by the personnel of the stores department, no additional cost is incurred unless overtime is required for checking, veri-

lying, etc. Such overtime is charged to the Stores Department account. If in addition to the perpetual physical inventory an annual or semiannual physical inventory is taken and additional labor used for this purpose, it is considered proper to charge the additional labor cost and also the overtime of stores personnel, if any, to general factory administration.

In many companies it is found necessary to close down the plant from one to many days in order to take inventory of work in process in the various stages of completion, and of plant and equipment.

The cost of taking inventory including the chargeable cost of plant shutdown should be charged to the account "Taking Inventories." This account should be studied from time to time to see if the cost can be reduced and to compare the cost of the work with its value. According to the theory of material control and perpetual inventories, no annual physical count of materials should be needed. Thus, through an analysis of the cost of inventory taking, the fact might be developed that additional or more highly skilled personnel in the stores department would eliminate the necessity for the annual physical inventory. It might, on the other hand, prove that the perpetual inventory was not dependable, in which case the cost of the stores personnel might be slightly reduced. The intangible cost of shutting down the plant for inventory purposes cannot be approximated in dollars and cents, yet it is a considerable amount, and the wisdom of the shutdown for this purpose should be questioned. Analysis of the "Inventory Taking" account and study of the storesroom organization and costs of operation will be of great assistance in determining the desirability of the practice of annual inventory taking.

**Analyzing Material Handling Accounts.**—From the classification of accounts shown in Chapter 6, the following accounts are set up for material handling:

- Supervision
- Clerks
- Laborers

Idle Time

Maintenance of Material Handling Equipment

Supplies

Printing and Stationery

Fixed Charges

Some of the above accounts are similar to accounts discussed in previous chapters, and for the most part fluctuate for the same reasons. Such accounts as Supervision, Clerical Work, Supplies, and Fixed Charges will not be discussed. The element of depreciation as a part of the fixed charges account, and the idle time account will be treated under the separate chapter headings.

The first account to analyze is the material handling labor account. One or many causes may be responsible for variations in this account between cost periods. The causes will, in part, be the same as the causes for fluctuations in direct labor costs and the analysis will proceed in a similar manner. The job time tickets or the standing order for material handling expense within a department are the records to be examined to determine the cause of fluctuations. Not only is it necessary to determine the causes, but to justify them as well. Some of these causes and their remedies are as follows: Changing location of sub-storesrooms, assembly rooms, layout, operations, or equipment may eliminate excessive handling costs. Better planning and scheduling of handling work may reduce idle time and permit a greater utilization of handling equipment and labor. The analysis might lead to the making of time studies of labor in handling operations to determine the most efficient method of handling, economical lifting, or carrying load.

The effects on output of attempts to reduce handling labor cost must be carefully considered. Sometimes it is possible to reduce the cost of handling labor in an operating department without apparent disadvantage, but if it produces idle time of productive labor or machinery it is poor economy. It may result in sufficient congestion at various points of operation to reduce productive activity.

**Substituting Mechanical for Manual Handling.**—The possibility of substituting mechanical for hand handling must always be uppermost in the mind of management. When analyzing the cost and utility of handling methods, time studies should be made to improve manual methods; relative space requirements must be studied; relative effects upon production must be determined; possible savings in materials handled (due to breakage, damage, etc.) as a result of the change in handling method, must be estimated; and the total cost of manual compared with the estimated cost of operation, maintenance, and depreciation of mechanical handling.

Frequently it is possible to employ mechanical handling, but the amount of work will not justify the purchase of the equipment. A careful survey may reveal the desirability of the use of similar handling devices elsewhere in the plant. Therefore, if the equipment can be scheduled to accommodate these various activities, its purchase may be justified. It must be remembered that it is not always true that estimated money saving is a real saving when other factors are considered. For example, in one company a belt conveyor running almost the length of the plant was installed to reduce handling costs, and while it accomplished this purpose the productive labor taking their parts from the moving belt were so slowed down that they were unable to make piece rate earnings. Dissatisfaction of the labor, reduction in output, and increased cost of output were the results which prompted the removal of the conveyor. The experiment cost several thousand dollars, and all to no purpose.

In another plant the installation of four industrial lift trucks eliminated enough hand labor to pay for the trucks in a little more than one year as well as speeding up the handling work to the point of entirely eliminating idle time of productive workers. Many other illustrations of economy and expenses due to changing from hand to mechanical handling, or vice versa, might be cited. It should be emphasized that yarding, unloading from cars, boats, or barges, offer excellent opportunities for reducing costs through the analysis of the cost of handling labor.

Other conditions which the analysis may bring to light are careless handling and spoilage of materials, lack of proper scheduling and system in collecting and distributing materials, equipment unsuited or obsolete, and incorrect deliveries. The indirect benefits from making this analysis may be far-reaching. It may serve to unearth conditions or policies which need correcting, for example, the analysis of material handling costs, including terminal and temporary storage charges and rentals, prompted one manufacturing concern to purchase waterfront property and erect its own warehouses, in which mechanical handling devices were installed.

**Analysis of Maintenance Costs of Material Handling Equipment.**—Each piece of material handling equipment, like all other equipment and machinery, is given a symbol number. This assists in keeping an individual record of each piece of equipment. If the equipment is permanently located in a department, its maintenance cost is charged to the departmental handling account. In case it is in general service under the material handling unit, its maintenance costs are charged to the proper account of that unit. At the end of the cost period the entire cost of operating the unit is prorated over the operating departments.

**Variations in Cost of Maintaining Material Handling Equipment.**—These costs will vary from year to year due to the decreasing life of the equipment. It is important, nevertheless, to analyze these changes, for it may be found desirable to replace certain equipment on which maintenance costs are running too high or, as is the case many times, the cost of replacing parts or making general repairs on old equipment is so great that it is economy to purchase new and perhaps better adapted equipment. As a rule, when heavy maintenance becomes necessary on a piece of equipment an estimate of the cost of the work is made beforehand so that the situation may be studied with a view to replacing the old equipment. An analysis of fluctuations in maintenance of equipment costs may bring to light defects in its manufacture, or advisability of changing the type of equipment.

The analysis of fluctuations in maintenance costs may be a factor in determining the desirability of periodic inspections or in planning for a general overhauling of equipment at stated intervals as a matter of policy. A rigid system of periodic inspection of all equipment may be very effective in reducing maintenance costs. Unless the most careful study is made in planning periodic maintenance, costs are certain to be excessive, for many times equipment will be overhauled when unnecessary.

**Investigate Maintenance Cost of Each Machine.**—There are many reasons why it is desirable to examine the cost of maintaining each piece of equipment. Defects in manufacture, design, or material of which the equipment is made may be determined. Abuse of equipment, improper use, poor previous maintenance work, relation of present and anticipated costs to the value of the equipment as compared with new or more modern equipment may be shown. Conditions under which material handling equipment is used frequently account for the excessive maintenance costs.

Climatic conditions, moisture, acid fumes, etc., may affect the equipment. For example, high cost of maintenance of industrial trucks may be caused in large part by the frequent replacement of tires, if the floors over which the trucks travel are not free from steel turning, broken glass, tacks, nails, acids, or are not in good condition. The analysis may lead to a careful study of load factor, method of operating, or other semi-technical aspects of the problem which have a bearing on the amount of maintenance required. A lack of proper supervision may result in rough handling, misuse, or abuse of the equipment, and thus cause breakdown and excessive wear.

**Analysis of Storesroom Accounts.**—The accounts generally used to cover the cost of storesroom operations are:

- Supervision
- Inspection Expense
- Clerks
- Assistants

- Labor
- Taking of Inventories
- Maintenance of Storesroom Equipment
- Discrepancies
- Printing and Stationery
- Fixed Charges

Changes in personnel or pay rates will account largely for the few fluctuations which occur in the storesroom accounts of supervision, assistants, clerks, and labor. The analysis of these accounts will, therefore, not only be of assistance in reducing the cost of these elements, but will serve other purposes of importance. For example, it may show increases in personnel which might have been necessary to expedite production, cost accounting, or production control. The increase might be modified by economies affected in the handling of materials through better dispatch and less idle time.

Fluctuations in these accounts may lead to an examination of the advisability of installing mechanical devices to assist in the keeping of records, or in the storesroom handling and issuing of materials. The introduction of office appliances has helped to reduce the number of clerks required to keep the stores ledgers. The introduction of computing scales has helped to reduce the personnel and time required to issue small parts which previously had been counted individually. In a chemical plant, automatic devices were found to be a great economy in measuring the filter cloth instead of the hand measuring.

**Inspection Expenses.**—This account covers all the inspection performed in the receiving department and in the storesroom. Under the chapter on inspection, the importance of raw materials and purchased parts inspection was briefly discussed. The most important point to consider in connection with the analysis of this account is the value of the work. There will be but slight fluctuation in the account as a rule, but this inspection may save many times its cost. The analysis and the reports of raw materials and purchased parts inspection will throw light on the various aspects of purchasing.

Where it is company policy to purchase on specifications, the inspector's report will show: (1) to what extent they are being followed by vendors; (2) the need for their clarification; (3) the quantity of materials consumed in inspection or test; and (4) the frequency of rejections. The analysis may reveal that a portion of the inspection work now handled by a highly paid inspector can be satisfactorily performed by the receiving clerk.

Costs of maintaining storesroom equipment (which consists of tanks, bins, racks, lockers, etc.) should not be a large amount if the equipment has been properly selected and has not been abused.

High maintenance costs of this equipment may lead to a consideration of new and different types. In one large manufacturing concern an analysis brought out the fact that the old wooden equipment was responsible for much damage to materials. Rather than expend the amount estimated as necessary to recondition the old equipment, it was decided to purchase new all steel equipment. This investment materially reduced stores insurance costs and damage to materials, speeded up the handling of materials, and eliminated a great deal of maintenance cost and reduced personal injuries. In one case, improperly maintained storesroom equipment resulted in serious injury to a storesroom employee, and a damage suit against the company which followed cost them several thousand dollars.

**Discrepancies Account.**—The discrepancies account of the storesroom covers the cost of all lost, damaged, or spoiled materials in storage and discrepancies in inventory.

The analysis of the discrepancies account will reveal: (1) the effectiveness of the control system; (2) the quality of storesroom operating; (3) the necessity for special conditions for storing materials; (4) the necessity for perpetual physical inventory; and (5) the necessity for better protection of materials against theft. In a novelty jewelry manufacturing plant in New England, discrepancies between physical and book inventories started an investigation which revealed the fact that systematic stealing of valuable raw materials had been going



on over a period. A lack of proper system of issuing and accounting for materials was responsible.

**Loss at the Receiving Platform.**—In checking up the possibilities of lost and damaged materials, special consideration should be given to the receiving platform.

In the work of receiving, many opportunities are present for damage and breakage of material, and unless proper care is exercised, much loss of materials may occur at this point. When deliveries are made by truck to the receiving platform, the receiving clerk must know that the number of pieces for which he is signing are present and that they are in proper condition before he signs the delivery sheet. Unloading to the receiving platform must be carefully supervised to prevent careless piling and theft of materials.

**The Indifferent Attitude.**—Satisfaction with passable performance seems to be a characteristic of industry, and perhaps there is but little incentive to better something which is working. This passive attitude toward mediocre performance sometimes promotes criminal waste and inefficiency. As has been pointed out in this chapter, the cost of material handling may not of itself appear to be excessive, but when congested operating departments, cost of idle men and machines, and other elements affected by material handling are considered, its costs may be much too high for the service rendered.

Consideration of all the interdependent factors which may be affected by any change will assist in determining if well enough is good or if further improvements should be undertaken.

## CHAPTER 22

### CONTROL OF IDLENESS COSTS

**Forms of Idleness.**—Idleness in its varied forms is prevalent throughout industry. Unfortunately, it is not possible to give even an estimate of the enormous annual loss to industry caused by idleness of various kinds. Conservative estimates of waste and loss through idleness and similar causes place the estimate in terms of many man-years at much over one million lost annually. The very nature of idleness makes it a subject of concealment in industry, and although it may be noticed here and there in individual concerns, it is apparently so insignificant that no attention is given to it. However, if the sum total of such idleness as exists in the average concern could be ascertained, no doubt this total would urge management to provide corrective measures.

A certain amount of idleness in some form or other exists in every business and, regardless of the excellence of its organization, management, systems, and supervision, it appears impossible to eliminate all the idleness. Granted that this is true, there is every reason to believe that the major causes of idleness can be substantially reduced, if not eliminated altogether. For example, certain unforeseen breakdowns of machinery will occur which apparently cannot be anticipated, yet it is possible through the proper system of inspection of machines at stated intervals to anticipate and prevent many of the otherwise unexpected breakdowns.

The major part of idleness and its resulting costs are due to the lack of preplanning or to poor planning. This statement is just as true and as applicable to capital in any form as it is to human energy. Idleness of capital or human energy costs money; how much, it is seldom possible to determine accurately. A salesman working on a commission basis knows

the cost of human idleness in his particular case, and so does the machine operator working on a piece rate basis. The banker knows the cost of idleness if his money is not out at interest, but many times the industrial executive fails to realize the cost to him of idleness of machinery, men, plant, and materials.

**Maximum Capacity Seldom Used.**—It is a known fact that but few industries utilize their plant to its maximum capacity. A recent survey shows that America's capacity to produce exceeds her capacity to consume by approximately 20%. This means that all forms of capital are not being fully utilized. It is not only from the standpoint of the loss to the individual and the company that the subject of idleness is important, but also from the standpoint of society. Our national growth, development, and economic position in the world may be seriously affected by this loss. The individual business in the past has been satisfied with making a fair profit and has not considered the cost of obtaining it. The known wastes of human and natural resources are abundant everywhere. Industry is now beginning to realize that this profit cannot be expected to continue in the future unless greater effort is put forth to reduce or eliminate waste and loss from all causes. The subject of idleness is of such great magnitude and is produced by so many causes that a full discussion cannot be given in this chapter.

**Definition of Idleness.**—Idleness may be defined as the failure to use properly the available facilities and energy in whatever form to secure the necessary maximum results at minimum cost and effort.

Much of the material included in this definition is not usually regarded as idleness. For example, the difference between plant capacity and its actual output is expressed in percentage of capacity. It is included as idleness in the above definition.

Likewise, individual machines not producing the standard amount for any cause are seldom spoken of as being partially idle nor is this lost capacity ever reported as idleness. If the

workman is not producing his standard output the difference between his actual production and the standards set is referred to as loss of a percentage of standard rather than idleness. It may not be idleness, as a matter of fact; it may be inefficiency or inability to produce more. If the machine has a standard capacity greater than that of its operator, there is an element of unused capacity of the machine which under the definition would be classed as idleness. Excesses of tools, machinery, equipment, labor, or space, although not generally looked upon as idleness, are so considered in the definition.

The extent to which idleness in these various forms exists in a given concern would, most times, be very difficult to measure. Furthermore, it would be almost impossible to eliminate or to obtain absolute control of some of these forms of idleness. The general headings of such forms of idleness as will be discussed in this chapter are shown in the following paragraph.

**Kinds of Idleness.**—All idleness has been classified under the following: (1) time idleness; (2) capital idleness; (3) space idleness; and (4) capacity idleness.

**Time Idleness.**—Forms of idleness discussed under this heading are limited to the idleness of personnel. Any failure to use properly the available energy for the desired purpose or result is regarded as idleness. If the broad meaning of the term is followed, there must be a certain amount of idleness which cannot be avoided. For example, a supervisor whose time is not fully required in supervisory work by reason of reduced personnel in his department is partially idle, but it is a situation which cannot be avoided and most times cannot be corrected.

However, where labor is not being utilized to the best advantage due to avoidable causes, there is idleness which should be eliminated. A further limitation will be placed on this discussion by not considering the personnel other than in the factory proper and its divisions.

There are other great factors which produce time idleness, such as unemployment, seasonal operations, strikes, lockouts,

boycotts, sit-downs, sickness, accidents, lateness, and absenteeism. Although these factors are of great importance they cannot be discussed in this chapter. Likewise, that idleness occasioned by laziness, loafing, restricted production, poor direction or supervision, and uncertainty of instructions, will not be discussed. Idleness in these forms is usually cloaked under a guise of activity, and many times it is impossible to measure the cost of it, although in some way, either directly or indirectly, its effects are visible. Much time and thought are being given to the reduction of idleness from these causes. High government and state officials, as well as the leaders in industry are striving to bring about a better balance of production with demand, to promote more cordial relations between capital and labor, and to introduce ways and means of overcoming seasonal variations of activity.

**Accounting Treatment of Time Idleness.**—For practical accounting purposes the causes of time idleness are listed in the classification of accounts shown in Chapter 6 as follows:

- Machine Breakdown
- Power Off
- Waiting for Work

These accounts are included in each departmental classification. When idleness results from any of these causes special time tickets (generally called idle labor tickets) are made out for the workman covering the idle time, with the reason for the idleness stated thereon.

These idle time tickets are first sent to the payroll department and then to the cost department. To facilitate classification of the reasons for idleness, the causes are often printed on the idle labor tickets. Making idleness the subject of a departmental charge offers the opportunity of placing the responsibility for it on the foreman. Oftentimes he has no control over the causes and can do no more than report them as due to stated reasons and insist that work be provided or conditions be corrected so that no idleness charge will be made against his department.

For example, if the power is shut off for some reason, the foreman is not responsible and can do nothing about the matter, or if there is no work, all that he can do is notify the production control division and await instructions. While it is recognized that the foreman cannot control many of the existing forms of idleness, the effect of making a charge against his department will urge him to a greater activity in attempting to reduce the causes or to secure action more promptly.

Occasional instances are found where departmental idle time occurs due to some extraordinary cause and is, therefore, not properly chargeable against the department. In case of fire alarms, the charge should be made against the account, "Fire Protection." Oftentimes, unavoidable accidents occur to workers which necessitate the temporary suspension of operations in the department. The cost of idleness from extraordinary causes should be either a direct charge to Profit and Loss or General Administration.

**Analyzing the Cost of Idle Time.**—From the viewpoint of the management, it is undesirable to wait until a fluctuation in the idleness account attracts attention. It should be analyzed each cost period in the endeavor to reduce all avoidable idleness. The premise should be that no idleness is necessary. The effort would then be to remove all idleness, or at least to find what idleness it is economical to eliminate.

In analyzing time idleness it is necessary to examine the idle time tickets or the standing order which covers the departmental idleness charges.

**(A) Machine Breakdowns.**—The costs of idleness due to machine breakdown are sometimes excessive. The reason for frequent breakdowns may be due to old machinery which has outlived its usefulness and which will presently be replaced by new machinery. Oftentimes extensive repairs will not be undertaken because of this fact, and therefore, frequent breakdowns occur. The cost of idleness and the cost of the temporary repairs plus the increased cost of reduced output must be balanced against the cost of extensive repairs or scrapping the old machine and purchasing a new one. Breakdowns may

be due to poor repairs, lack of repairs, careless operator, new or untrained operator, incorrect setup, wrong speed or feed of the machine, lack of oiling, and numerous other technical causes.

In the majority of cases machine breakdowns may be anticipated. The weakness, or wearing part of a machine will usually be visible to a properly trained inspector before the break occurs.

**(B) Power Off.**—Idleness of both labor and machinery may be caused by power shutdowns or lack of adequate power to drive the equipment. Most times "no power" is caused by breakdowns in generating or transmission equipment. Where motors are used to drive groups of machines, the motor may go out of order and cause their shutdown. Idleness caused by machine shutdowns will be treated later in the chapter. Where too frequent breakdowns in power plant equipment occur, it may be an economy to install emergency lines from a utility company.

Where shutdowns of power plant can be anticipated, the production department should be advised well beforehand in order that necessary rearrangement may be made in production schedules and the use of labor. The production department can plan to use the labor on other work or advise them beforehand of the layoff so that they can arrange their plans. Careful inspection of power plant equipment at periodic intervals, and careful scheduling of repairs in view of other departmental requirements will reduce the costs of power shutoffs. Likewise, stand-by equipment may more than pay for itself by being available for emergency use.

**(C) Waiting for Work.**—Idle time from this cause may be a result of one or more of the following conditions:

1. Lack of material.
2. Lack of instructions, orders, or specifications.
3. Machine under repairs.
4. Waiting for machine setup man.
5. Waiting for tools.

6. Mistakes in materials, tools, specifications, instructions.
7. Waiting for an inspector.

The analysis of the cost of this idleness should be made by individual causes.

The standing order covering the cost of idleness from "waiting for work" will give the causes as shown above. If no standing order is issued for this purpose it will be necessary to compile from the labor time tickets the detailed causes for idleness under this major class. The analysis of the time tickets will reveal the causes but the reasons underlying these causes cannot be determined without the examination also of other departmental costs and activity records.

For example, waiting for work due to no materials may be caused by poor material handling, failure of the production control division to requisition materials out of stores, failure of the storesroom to send out materials as instructed, and shortage of materials in storesrooms.

"Waiting for work" also might be caused by the material handling division not being prepared or immediately available for removing large pieces from machines, or for placing heavy materials in the machines. Lack of instructions or specifications in the hands of the workman may cause idleness of this nature. If the worker is on piece rate, he will no doubt go after the needed instructions or specifications, but if he is on day work he may wait until they are furnished to him. Unless the instructions or specifications have been prepared and are available, the workman may be obliged to wait a long time for them, even though he immediately reports the fact. Proper planning and correct location of instruction boards help to prevent this form of idleness. Although it does not appear as idle time, much time is lost by workers in starting and stopping of jobs. They must go to the timekeeper at the beginning and ending of each job unless job clocks are provided or they must wait until the instructions for the next job are brought to them.

**Lack of Planning.**—Lack of planning by the foreman after he has been notified that repairs will be made on a certain



machine at a specified time results in idleness. If it is an emergency repair it may not be possible for the foreman to find other work for the man, or it may be that the man is not capable of doing other available work. Means of eliminating and reducing idleness due to machinery under repairs were discussed above under the subject of machine breakdowns.

Waiting for tools is largely due to poor planning. If the workman must go to the toolroom for his tools he may be delayed in getting a requisition approved by the foreman, or by waiting at the tool crib for the tool.

Many plants consider it economical to have capable mechanics responsible for all "machine setup work." Each workman is supposed to report the finishing of a job so that his machine may be set up for the next job. In case a "setup" man is not available at that time, the workman must remain idle until his machine is properly set up. This condition frequently exists where automatic machines and power presses are in use.

**Wrong Materials or Equipment.**—If incorrect materials, tools, or instructions are given to the shop, delay follows. Often materials and tools are sent to the wrong machines; wrong instructions are given to a workman; and sometimes incorrect specifications have been issued by the engineering department. Granted that these conditions should not exist, the practical side of this matter is that these things do happen and they must, therefore, be recognized and dealt with.

Oftentimes a workman starting a job cannot proceed until an inspector has examined the trial run to check the setup. Failure to provide inspection at the time needed may cause idleness of the workman. Planning the inspection work carefully, and cooperation between production control, inspection, and the foreman, will usually reduce idleness from this cause.

Such factors as temperature of the working place, lights out, minor accidents, medical inspections, visitors, breaking in new men, unsanitary working conditions, time study man interfering, and personnel interviews may occasionally cause small amounts of idleness.

**Capital Idleness.**—This form of idleness includes money, land, buildings, machinery, equipment, and other such elements. For many reasons the discussion which follows will be confined to machinery and equipment. The major causes for idleness of machinery and equipment are: (a) machinery

(Department No. _____ Machine No. _____ Name of Machine _____ Idle from (date) _____ to _____)			
CAUSES	WAITING	DEFECTIVE	HOURS
Power			
Repairs			
Materials			
Tools			
Operator			
Work			
Instruction			
Remarks _____ Signed _____			

(Face)

<b>READY FOR OPERATION</b>
Repair Man _____ <div style="text-align: right;">Signed</div>
<b>MACHINE IN OPERATION</b>
Departmental Foreman _____ <div style="text-align: right;">Signed</div>

(Reverse)

Figure 34. Idle Machine Record Card

under repair; (b) no work; (c) no operator; (d) no power; (e) no tools; (f) failure of other facilities and numerous other causes. Practically all the reasons for time idleness will result in machine idleness as well. Inasmuch as these causes have been listed and discussed they will not be considered here.

**Importance of Statistics of Machine Idleness.**—The usual cost accounting practice is to exclude from the cost books the cost of machine idleness. This may be justified on the grounds that it is a difficult task to determine the cost of

machine idleness. Notwithstanding this, it is of the utmost importance that accurate records be kept of machine idleness to facilitate the operation of the production control system and also to aid in the measurement of supervisory effectiveness.

Such a record may be easily kept through the system of using machine boards in each department where jobs are placed according to machines. When there is no job for a machine, a colored tag (Figure 34, usually red) is filled out and placed in the pocket under the number of the idle machine. When a job is assigned to the machine, the red card is removed. The card is made out in the department where the idle machine is located. A copy is sent to the production control division and the original placed on the board. When work instructions for that machine are received in the department, the time the machine is put into use is noted on the card and is forwarded to the factory manager. The copy in the production control division is utilized in scheduling machine work and planning for other jobs.

In addition to assisting the production department in scheduling the use of the machines for production this card, while on the departmental machine board, is a constant reminder to the foreman that his departmental expenses are increasing.

**Use of Machine Control Board.**—The machine control board system may be used for both general and special machines. If the system is used for both kinds of machinery, it is suggested that different colors be used to designate each class of machine. This will be a convenience to the foreman and will assist in sorting the cards preparatory to the making of a statistical report for the factory manager.

No provision has been made on the idle machine record card to show the cost of the machine idleness. If the factory manager desires estimates of this cost, they must be secured from the cost department. Inasmuch as the expense loading on a machine will change but little where the idleness is of short duration, the task of furnishing these estimates will not add greatly to the work.

From these idle machine cards a daily chart is made for the factory manager, showing the number and class of machines idle daily. In addition to this chart, studies of machine idleness should be made over a weekly or monthly period according to classes of machines, departments, and causes of idleness. This report serves as a basis for action in the reduction of idle machine time. If the lack of repairs is the cause of idleness, the factory manager investigates the reasons for delay. If idleness is due to power being off the power department must explain the reasons for the shutoff. In each case he consults the person in charge of the function which was responsible for the machine idleness in order to find out what the causes were, what preventative steps have been taken, and what action on his part is necessary to prevent recurrences.

**Initiating Reduction in Machine Idleness.**—Frequently the factory manager calls the chief inspector, chief engineer, production manager, and the operating superintendent, to discuss with them the extent, costs, and causes of machine idleness and ways and means of preventing much idleness.

A study of idleness costs may lead to the development of new products, new sales plans, or rentals of space, to aid in eliminating idleness. One well-known concern developed an allied line of products which they sold without profit in order to absorb a share of the manufacturing expense. This additional absorption of expense increased the profits on their regular line.

**Space Idleness.**—This form of idleness includes unused space only. Often a concern erects or purchases factory buildings which contain greater floor space than is needed at the time. Expansion and future needs may have been considered, and perhaps it was advisable to secure the additional space. Nevertheless, in the interim there is unused space which is costing money. Generally, it is possible to weigh the cost of unused space against present or future building costs. Although the balance may be on the right side, it is the duty of management to analyze the cost of idle space to determine if it cannot be utilized in a profitable way. Oftentimes, changes in plant

layout may be made which will not only utilize waste space but reduce manufacturing costs through a more effective layout. The idle space may be rented to an allied or complementary producer, which may add additional profit through better service or the utilization of waste materials.

From the viewpoint of department heads, most plants are without adequate space. However, before this additional space is provided, it is wise to make a careful study of layout versus requirements to see if changes cannot be effected which will serve adequately the need of these departments.

A foreman dislikes to have his department charged with space which he is not using, and sometimes pointing out to him the cost of increasing space according to his demands may convince him that he can do very nicely with his present allotment.

The cost of space includes insurance, taxes, depreciation, upkeep, plus the interest on the capital invested in the unoccupied floor space. If the building is rented, the cost will consist of rent, along with building maintenance. Idle space within a department is charged to that department. Where the idle space consists of an entire floor or building, it is charged directly to factory administration.

**Capacity Idleness.**—Operations conducted at the maximum rated capacity of the machinery and equipment are practically impossible. Such an ideal situation permits no interruptions from any cause, including breakdowns, power shutoffs, lack of personnel, equipment, materials, tools, etc., nor does it permit the operation of a machine at less than the maximum rated capacity. Maximum capacity of plant is, therefore, seldom referred to, and instead standard or normal capacity is made the basis for calculating output.

Standard capacity makes allowances based on experienced job factors and conditions which actually arise from time to time. When standard capacity is determined it is equivalent to saying the plant is capable under normal or average standard conditions of operations, personnel, organization, and management, of producing this amount. Every executive knows

that certain interruptions to operations occur from time to time, and while it may not be possible for him to anticipate from what source the interruption will come, he can anticipate with reasonable accuracy the loss due to such interruptions over a given period. Therefore, in determining the standard capacity of the plant, due allowances are made for these factors which experience has shown will cause interruptions. Admitting that much of the loss from interruptions may be prevented, there remains a more or less constant amount of loss which is taken into consideration in this connection.

There is a third figure of capacity which is commonly called predetermined or operating. This figure is based upon the budget which has considered sales expectancies, plant possibilities, and business conditions. The predetermined output may be the standard output, or it may be, more or less, depending upon the factors already mentioned. It is seldom greater than the standard, for management realizes the difficulty in producing more than the standard at reasonable cost of production. When output requirements exceed standard productive capacity multiple-shift operation is often resorted to.

**Cost of Maximum Output.**—The cost of maximum output is impossible to calculate. At best, no more than a fair estimate can be made. However, it is desirable at times to make such an estimate for information purposes. Management may find it profitable to compare the cost of output at maximum capacity with the cost at standard and operating capacity. In case operations are below standard capacity, the increased unit costs of production will be due partly to the causes of idleness previously mentioned, or failure of the sales department to supply the necessary orders for finished product.

The predetermined capacity representing the planned output for the coming period is based upon expected sales, business conditions, ability to produce the amount, and perhaps finances. The difference between predetermined capacity and standard capacity represents the possibility of savings or additional cost of operations. It may not be possible from a standpoint of economic conditions to dispose of standard capac-

ity output and, therefore, a smaller output is determined upon. If the prorated increase of the unit cost of the reduced output is too high when compared to the cost of output at standard capacity, it may urge the management to provide a larger advertising appropriation, employ additional salesmen, develop an incentive plan to stimulate sales, open up new territory, produce loss leaders to help absorb manufacturing expense, or resort to other plans in order to keep down the unit cost of output.

Many instances may be cited where management has developed by-products, similar lines, etc., to absorb unused capacity, and thus have a greater output over which to charge the cost of manufacturing.

**Responsibility of Management.**—"The cost of idleness," says one well-known writer, "is the cost of carelessness, and carelessness is an unforgivable sin in industry." The responsibility for reducing idleness to the minimum is very definitely up to the management of a plant.

The causes of idleness discussed in this chapter are more or less extraneous to plant operations and therefore should not exist. Idle time, machine breakdown, space and capacity idleness all exist to a much greater extent than should be permitted. The only way in which business executives can face their responsibility in this connection is to determine the costs of idleness, analyze these costs, and fix individual responsibility for its reduction and elimination. Only through a knowledge of the causes, costs, and origins of idleness, can management get at the heart of the problem.

For example, if it were possible to submit to the maintenance department at the end of the month the cost of idleness due to lack of improper maintenance, it would be impressed with its shortcomings, and the necessity for careful planning and performance of all maintenance work would be strongly emphasized. If it is necessary to predetermine the output at 20% under standard capacity output, due to a lack of sales orders, the sales manager should be shown the cost of this idle capacity, and informed that his department will be

responsible for the expected reduction in profits. No more effective way than this can be found to measure the efficiency of departmental executives and the wisdom of company policies.

Idleness in industry is not the product of a fertile imagination, it is one of the most concrete as well as one of the most important problems of management.

No further comment is required to emphasize the urgent necessity for an effective program for waste reduction.



## CHAPTER 23

### CONTROL OF FACTORY ADMINISTRATION COSTS

**Factory Administration Department.**—Consistent with the plan of organization set forth in previous chapters, the factory administration departments, although closely allied to each other, must be handled as separate units. From the standpoint of management, these activities are more or less service units to plant operations and, therefore, the cost of operation form a part of factory instead of general administrative costs. These plant management service departments are as follows :

1. Factory Administrative Department
2. Engineering Department
3. Purchasing Department
4. Production Control Department
5. Employment Department
6. Cost Department

There is a great deal of discussion among accountants concerning the proper accounting treatment of the latter five departments. Many contend that they properly belong to factory administration, because they serve the operating departments. Other accountants argue that not all the work performed by these plant activities is needed by the factory, but that the work is desirable from the point of view of general management and therefore, their costs should be charged in whole or in part to general administration. In large manufacturing concerns, certain work is performed by the engineering, purchasing, and industrial relations department which is not needed and does not apply to plant operations. Certain educational projects may be undertaken by the personnel department, which may consider clerical workers, junior executives, wives of em-

ployees, etc. Although such projects may benefit the factory indirectly, most accountants regard the cost as a direct general administrative charge instead of a charge against factory administration.

In a large manufacturing plant in the Middle West, there is a naturalization bureau functioning under the personnel department. This bureau renders service to foreign born employees in securing naturalization papers and also does much work described as Americanization. The cost of operating this bureau is charged, along with other personnel department costs, to general administration. In an attempt to bring together the major elements of manufacturing costs, the above departments have been placed under the group heading of "Factory Administration." If it is desired to charge the costs of operating these departments to general administration and to prorate an equitable share of the costs over the factory it may be easily accomplished.

**1. The Factory Administrative Department.**—This represents the plant superintendent or factory manager and his staff. The segregation of this activity as a department serves as an accounting convenience in assembling certain items of costs, such as plant supervision, which enters into the total cost of manufacturing and which cannot be readily charged to the productive departments at the time the costs are incurred. The distribution of this supervisory expense should be made first against producing and service departments according to their appropriate share, and then the total service department's cost should be redistributed over the producing departments. The following accounts are usually found under the factory administrative department:

- Supervision
- Clerks and Stenographers
- Vacation
- Traveling Expense
- Sickness
- Military Service
- Maintenance of Buildings

Safety and Sanitation  
Fire Protection  
Fixed Charges

The majority of the accounts in this department are composed of the same elements as are similar accounts which have been previously treated. There are, however, two or three new accounts in this classification which require discussion.

**Vacation and Sickness Accounts.**—The accounts of vacation and sickness are treated together for convenience. In some plants the practice is to charge directly against the department concerned such amounts as are paid to an employee on vacation or during illness. Often an additional employee is required to fill the position of one who is on vacation or ill, and the department head objects to paying wages to the two persons. If it is desired to pay an employee while he is away, his wages are charged against factory administrative costs. The department is charged with the wages of the substitute employee. If the cost of sickness appears to be abnormal it is desirable to analyze the account. Cases are known where employees have deliberately falsified about illness in order to have time off and be paid during that period. The cost of sickness may rise to a point where an investigation is made to determine the cause for the unusual amount.

The cost of medical care and sickness account should be carefully analyzed in conjunction with the absentee report and the causes of illness and accident. It may be found that the following causes and conditions are responsible for increased costs:

- (a) Bad working conditions in the plant.
- (b) Poor equipment causing accidents.
- (c) No blower system to carry away dust and fumes.
- (d) No goggles, gloves, or putties used by workers.
- (e) No safety devices on or around machines, or moving belts, etc.
- (f) Bad floor conditions.
- (g) Poor food obtained from small restaurants near the plant.

- (h) Contagious diseases brought into plant.
- (i) Hours of work too long, men working in acid fumes, dust, or at furnaces.
- (j) No medical inspection of prospective workers.
- (k) Bad sanitary conditions in or around the plant.
- (l) Poor selection of the worker by the personnel division.
- (m) Poor drinking water.
- (n) Insufficient medical care of workers.

In a large plant in central Tennessee the cost of sickness grew so high that the management started an investigation. Work was interfered with and the expense of paying full wages to employees who were sick became a burden. The investigation disclosed the fact that the drinking water was badly polluted, and many cases of typhoid had resulted from the employees drinking this water.

**Safety and Sanitation.**—The function of safety and sanitation should be under the supervision of a skilled engineer thoroughly familiar with all details of plant, machinery, and healthful working conditions. Frequently this work is performed under the supervision of the employment, maintenance, engineering, or factory administrative department. Wherever possible the cost of safety work should be charged directly against the department receiving the benefits other than the costs and installation of safety devices, which should be capitalized. Sanitation usually affects the plant as a whole, although the work may be performed in a given department. The analysis of the safety and sanitation account will give some idea of the value of the work represented by this account as compared with the cost of sickness, cost of insurance, and number of accidents during any cost period. The degree of satisfaction expressed by the working force with proper working conditions, sanitation, and safety provisions is an important matter to be considered, although it cannot be accurately measured.

**Fire Protection.**—In practically every state there are certain minimum legal requirements for fire protection in factories.

The cost of fire protection equipment is capitalized. The maintenance of this equipment is usually charged to the fire protection account, although the work of maintaining it is cared for by the maintenance department. The cost of the paid fire protection organization is also charged to the fire protection account. In most cases, periodic fire drills are required by law. Usually, workers on piece rates lose the time devoted to fire drill, while those on hourly rates suffer no losses, as their time is charged against the job on which they are working. The fire protection account will seldom be large unless there are exceptional costs of maintaining fire protection equipment.

The cost of fire protection should be examined in connection with the number of fires in the plant, cost of such fires, insurance rates, and the hazard to employees. As in the case of safety and sanitation, adequate fire protection prevents employees from feeling undue alarm concerning fire hazards, and dissatisfaction because of possible difficulty of escape in case of fire.

One large company makes it a rule to issue a manual to each new employee on the subject of fire protection. This manual gives details of fire equipment, location, signals, instructions for conduct during fires, drill relations, and methods of putting out small fires, and of preventing fires. In addition, this company has a paid fire chief to supervise equipment and drills, and an organization of the employees for fire-fighting.

**Fire Drills.**—Fire drills must be held to comply with state laws and they should be carefully carried through. The plan of holding fire drills prior to beginning work, that is, asking employees to come fifteen minutes earlier for fire drill, is not successful, although it saves productive time. In one plant, fire drills were held five minutes before lunch time. This time was selected because it represented a minimum loss of time to the employee as well as to the factory. The measurable cost of fire drills is charged to the Fire Protection account.

**Fixed Charges.**—The Fixed Charges account will be the same as in other cases which have been treated previously, with

the exception of the Insurance account. This will include not only the fire insurance but also a portion of the employer's liability, social, and unemployment insurance. The cost of the latter three is distributed over the departments according to the amount of the payroll in each. The account should be carefully examined in connection with accidents, safety, sanitation, and fire protection. Most states require manufacturers to carry employer's liability insurance with a private carrier or in a state fund. The cost of this insurance is usually high, and much may be done to reduce its cost through an active safety and accident prevention program.

The amount of money spent in this direction should bear some relation to the cost of insurance and the results secured by the expenditure. There are certain other accounts, such as Heat, Light, Stationery, and Printing, and various other small accounts which have not been mentioned because they are relatively unimportant.

Additional accounts which are required but cannot be made a matter of direct departmental charge may be included under the heading of Factory Administration.

**2. Engineering Department Costs.**—In the average manufacturing concern, technical engineering service is a necessity. The work of the department is varied and plays an important part in the success of the business. It is not only concerned with the machinery and equipment but has much to do with the design, perfection, and production of the product. The amount of plant output, the quality, and in large part the cost of plant operations are materially affected by the skill and ability of the engineering organizations.

**Functions of Engineering.**—The function of engineering divides itself into the following six main divisions: design, research, plant engineering, drafting, blue printing, and field engineering. A most important part of the department's work is cooperation with the other departments of the business where its technical advice and assistance may be of value. Practically every phase of plant operations interlock with the engineering department's work, and the function must be so

organized that there will be opportunity for the greatest possible cooperation. (See Chapter 9.)

**Organization of the Engineering Department.**—The engineering function is under the jurisdiction of the chief engineer with an assistant in charge of each of the divisions mentioned above. The entire engineering organization is for the most part composed of technical men, each working at assigned tasks; it is, therefore, a question of quality of work rather than quantity. The organization of the department must be so constituted that functional control may be exercised over inspection and toolroom activities, and it must be prepared at all times to render service to the production, purchasing, and management departments. The engineering department should assist the sales department in training technical salesmen, educating customers, mechanics, millwrights, etc.

**Accounting for Engineering Department Costs.**—The major accounts to which the cost of the engineering department's work is charged are as follows:

- Supervision
- Technical Assistants
- Clerks
- Stenographers
- Office Supplies
- Traveling Expense
- Experimental Expense
- Fixed Charges

It would be difficult to charge directly to a given department any portion of the cost of operating the engineering department on the basis of services rendered. For example, engineering specifications for materials are submitted to the purchasing department. The purchasing department receives no direct benefit from this service but utilizes the service to benefit the shop and the management. Likewise, the engineering department submits drawings, parts lists, and operation sheets to the production department, but this information is used for the benefit of the producing and service departments.

In order to prevent complaints from department heads on charges for engineering service, it is desirable to charge the total cost of engineering department operations directly to the manufacturing expense and prorate it to the various departments.

**Analysis of Engineering Department Costs.**—The accounts covering supervision, clerks, stenographers, and fixed charges are similar to the accounts of the same names which have been discussed in preceding chapters with the exception of office supplies.

In addition to the usual office supplies, the engineering department consumes a large quantity of drawing paper, tracing cloth, blue-print paper, drawing inks, and drawing pencils. These materials are expensive, and the cost of office supplies may be excessive unless proper care is taken of them.

**Technical Assistants.**—This account will include the services of engineers, draftsmen, designers, and other technical or semi-technical assistants. The cost of these services will usually remain constant between cost periods, although the account deserves attention from the point of view of the work turned out. This class of work is slow and tedious and sometimes this fact is advanced as an excuse for low production or high cost of this service. In a New York City engineering office where the cost of technical assistants seemed too high, the principles of production control were applied to the work performed, resulting in decreased cost and increased volume of output.

**Traveling Expense.**—Traveling Expense in the field engineering division sometimes amounts to a considerable sum, and it is desirable to examine the account from time to time. In order to keep the Traveling Expense account at a reasonable figure many plants have set up allowances for traveling expenses exclusive of transportation fares. Receipts for fares and certain other items of expense must accompany the individual engineering expense book when it is turned in. The



value of the field engineering work cannot be measured by the costs of operating this division. The satisfaction of the customers and the increased good-will, besides the additional opportunities to make sales of other products, are as a rule worth more than the cost of rendering the service.

Many concerns are always anxious to send their field engineers out to consult with plant management on machines, power, and other problems which may or may not result in a sale of product.

The cost of this service is regarded as money well spent in paving the way for future sales. The cost of operating the division should be analyzed in connection with other factors which may more accurately reflect the value of this service. For example, volume of sales, cost of sales, and in case the field service is rendered for adjustment of trouble with the product, inspection, manufacturing design, fabrication, or materials will enter into the consideration.

**Experimental Expense Account.**—This generally covers the cost of labor and materials consumed in experimental process development, product development, and experimental tooling or machines. Constant research and experiments are being conducted by the engineering department in the effort to develop new products; add utility or sales value to old products; utilize waste products, by-products; establish new and simplified processes; expedite production; permit the use of substitute materials; equipment and labor. The nature of the charges to this account makes for wide fluctuations from period to period.

The activities of the department may be intermittent and may require but little labor or materials on one experiment, and large quantity of expensive labor or materials for another experiment, much of which may be spoiled during the experiment. For example, experimenting on a new annealing process involved the consumption of considerable materials and labor until the process was developed into the practical working stage. The change in method from the old gas or oil-burning furnace to the electric furnace method reduced the time and labor required and eliminated the use of annealing pots. Where

experimental machines are being developed and eventually put into production, then the cost of the developed work may be legitimately capitalized.

**Difficulty of Analyzing Experimental Expense.**—In analyzing the cost of operating the research division it will not suffice to compare the costs for one period with those of a previous period. The only way in which the analysis will be of value is to compare the cost of operating the division with the results of the work accomplished.

This is very difficult to do, for the money spent may not produce tangible results in a particular period. All operating departments benefit through experimental work and where possible the benefits or savings in these departments should be measured against the cost of operating the experimental division.

**Value of Engineering Department Work.**—Inasmuch as it is a department constituted to render service to other departments, the cost of its operation should be reflected in savings made in the departments served by the engineering department. For example, the cost of the design and research work should show savings in labor, materials, machines, or perhaps bring about increased output. In a large radio manufacturing company the research engineer discovered that a composition might be substituted for a solid rubber part, thus saving the company a large sum of money annually. In a large publishing house the engineering department studied the productive machinery and found that by making certain changes in design of one machine and adding additional parts, this special machine could be turned into a general purpose machine, thus reducing the investment and bringing about greater utilization of the machinery.

**3. Purchasing Department.**—The work of purchasing in a fair-sized manufacturing plant is of sufficient importance to warrant placing the function under a separate head. Purchasing is usually regarded as a service to manufacturing, although in the normal course of business operations the purchasing

department functions as a separate unit. That is, the work of buying printing and stationery paper, office supplies, and equipment is likely to be performed by this department. The cost of this service, as well as the cost of making personal purchases for employees, etc., represents a small part of the cost of operating the purchasing department, and for this reason it seems unnecessary to endeavor to charge general administration with an accurate proportion of purchasing department operating costs.

Unless the work of purchasing is well organized and functioning under a central head, it is very difficult to obtain accurate costs of operating the activity.

In analyzing the operating cost of the department the executive should consider the costs in relation to the supply of materials provided; interruptions to production due to lack of materials; financial savings made through opportune purchases or contracts; and savings in the cost of materials through efficient buying methods. The ability of the purchasing department to cooperate with the financial department and to buy economically within maximum and minimum stock limits is to be considered.

In the statistical unit, graphs and curves are made showing trends in material prices, market fluctuations, and cost of raw materials. A comparative study of these figures in connection with the cost of operating purchasing department may help in evaluating the work and the reasonableness of the costs of its operation.

**Analyzing Purchasing Policies.**—In Chapter 15 it was pointed out how fluctuations in the cost of direct materials might lead to an analysis of the purchasing department policies. In analyzing the cost of purchasing, the policies will again come up for consideration. This study of policies may lead to changes in method or organization which will reduce the cost of operating the department.

**Accounting Treatment of Purchasing Department Costs.**—The accounts usually found in the purchasing department are:

- Supervision
- Buyers' Salaries
- Clerks
- Stenographers and Typists
- Printing
- Supplies
- Traveling Expenses
- Fixed Charges

There are other small accounts which are included in this department, such as Heat, Light, Drinking Water, etc.

Many plans have been suggested for distributing the cost of purchasing department operations to the productive and service departments. No plan is known which will enable a correct allocation of the cost of purchasing to the various departments, and it is, therefore, the usual practice to charge the cost as a lump sum to manufacturing expense. Many accountants make the distribution on value of materials purchased, services rendered, weight or bulk of materials, or labor hours but none of these methods is accurate.

Many of our large industrial concerns are charging the costs of operating the purchasing department to the materials purchased, thus increasing the cost of raw materials. This practice is legitimate but it is extremely difficult to determine an equitable basis for proportioning charges on the cost of various materials purchased. The individual concern must determine a ratio of purchasing expense cost of materials purchased over a period of time and apply this ratio to the cost of each material. In this way the purchasing expense will be absorbed.

In the average plant it is impossible to measure the purchasing services rendered to a given department, and many times there is no connection or relation between the weight and bulk of materials or hours of labor expended and the cost of purchasing materials. Inaccuracy and unfair departmental charges are the usual result of an attempt to distribute the purchasing costs over the departments concerned, and it is therefore advisable to follow the plan of charging the purchasing department cost to manufacturing expense in toto.

**4. Production Control Department.**—The degree to which production control may be carried depends primarily on the type of industry and the class of product handled. The work of a production control department usually consists of production planning, routing, scheduling, dispatching, movements of materials, time study, rate setting and the record control of all operating activity. Each of these control factors is of vital importance to manufacturing and has a distant bearing on the costs of production.

The production control unit is purely a factory administration function dealing exclusively with plant operations and their control. For this reason the costs of operating the department is a part of factory cost and should be charged to the operating departments based on the amount of work performed by the production control unit, in each of the respective productive departments. The importance of production control activities on costs and cost reduction is discussed in Chapter 10. The expense accounts of the department are similar to those found in the cost department.

**5. Accounting for Employment Activities.**—The work of a modern personnel department covers a wide range of activities dealing with the personnel of the entire organization and frequently the wives and children of the workers. It would, therefore, seem inadvisable from an accounting standpoint to discuss the subject of personnel as a part of factory expense alone. As a general rule, there is no division of activity in this department which renders exclusive service to the factory. In cases where the factory is located in one city and the main office in another city, certain phases of personnel work carried on at the factory serve it exclusively and, therefore, would be a part of the cost of operating the factory. In distributing the costs of operating the personnel department, the problem arises of correctly allocating the costs between the factory, the general offices, and sales department. No absolutely accurate method of making this distribution can be suggested. The logical basis is the services rendered. This is in most cases difficult to determine. The cost of employment, training, and

medical services may be more easily allocated than costs of recreation, education, or welfare work. One large manufacturing plant spreads the cost of employment, training, and medical service over the various departments of the factory, main office, and sales department according to the number of workers employed. The method of distributing the costs of personnel activities on the basis of labor turnover in the various divisions of the business does not seem equitable; neither is the plan of charging personnel costs to general administration entirely satisfactory. It is perhaps the more usual practice to charge employment, training, and medical service to factory administration as a lump sum, and to charge the other personnel activities to general administration. It is understood that the items charged to factory administration consist, as far as it is possible to determine, of only such portions of the total costs of these items as can be definitely allocated to the factory.

**Organization of Personnel Department.**—In some of the larger companies where personnel work is regarded as a major activity, the function is headed by a director or manager reporting to the general manager. In the smaller companies, the personnel director may report to the factory manager. The more usual divisions of the personnel department are employment, training, medical service, and welfare. Each of these divisions is headed by a manager or supervisor who is assisted by a staff determined by the requirements of the work. The character of the work performed by the personnel department requires a very carefully built up organization and the proper selection of its staff. The activities of this department must be discharged without duplication, overlapping, or friction. In this department where the value of the work depends largely upon the skill and ability of the staff, who come in contact with present and prospective employees, it is highly essential that the various divisions of personnel activity work in close cooperation.

**Accounting Treatment.**—The costs of operating the service divisions will be discussed in this chapter. Other divisions

will be discussed in the chapter on general administration. The following accounts are common to the above three divisions:

- Supervision
- Clerks
- Stenographers
- Training Expense
- Medical Services
- Printing and Stationery
- Fixed Charges

**Training Expense.**—With the exception of the accounts, training expense and medical service, the accounts mentioned above have been previously discussed. The classification of accounts in Chapter 6 shows a training expense account for each department. Where an employee receives his training within the department in which he is to work, the cost of such instruction is charged to the departmental training expense account. Where instruction is given through the training department, or through an outside agency such as a university or technical school, the cost of such instruction is charged to the training expense account of the personnel department. For example, in the average machine shop, a new employee working as a lathe operator is given such instruction as he requires in the department. During the learning period, lasting usually until he is able to produce the standard hourly output for that job, the expense of the instruction is charged to the departmental training expense account. At the same time this account is credited with the output of the new employee at the customary piece rate or other method of paying for work done on that machine.

**Analysis of Training Expense Account.**—In a large manufacturing concern the cost of training amounts to a considerable sum of money. The cost must be carefully analyzed to see that the training is not costing more than it is worth. One large department store operates an extensive training section. The average training period is three to four months for junior executives, and the labor turnover records show that a large

proportion of these employees leave within one year. This store is unable to determine the value of training in this case and continues to do training because it does not know if better results could be secured otherwise. Much money can be spent on training without producing the best results. The problems of training must be carefully analyzed before the training work is undertaken, and only through analyzing the cost of the work on the basis of the value of the employees trained and the duration of their employment with the company, can the reasonableness of the cost be determined. The reduction of labor turnover, spoiled work, breakage and damage to tools, machinery and equipment is many times the results of lack of training.

Difficulty is found in measuring the value of training through these elements, but they should be given consideration in analyzing the cost of training. Company policies, wages, hours, training, personnel, methods, facilities, selection of those to be trained, and duration of training are among the factors that influence the cost and effectiveness of training.

**Analysis of Medical Service Account.**—This account will fluctuate but little between cost periods, and an analysis of the account will show but little. The chief value of examining it is in connection with the study of accidents, which have produced loss of time, legal suits, dissatisfaction of the employees, better selection of employees through physical examination at time of employment, services rendered to employees through periodic physical examination, and adjustment of work on basis of physical condition of employees. The cooperation of the medical service division with the production control unit in connection with the making of time studies, job analysis, and job specifications; with the safety and sanitary division in protecting the workers in every possible way, and the value of first aid treatments, the control of contagion, the general advice and medical service rendered to the workmen and their families should also be considered when analyzing this medical service account.

**6. Cost Department Activities.**—The primary function of the cost accounting department is to collect and record in a



usable and orderly way all elements of the costs of manufacturing. The cost department does not concern itself with selling and administrative expenses as a general rule. These matters are usually handled through the general accounting system. If the cost department visualizes the opportunities which are open to it, not only will it collect and record all elements of business costs, but it will render a helpful service to the management in connection with analysis, interpretation, and use of these costs.

**Opportunities of the Cost Accountant.**—Familiarity with the work performed in the shop and a good understanding of the problems confronting management are valuable to the cost accountant in enabling him to render a real service to his company. The task of collecting and recording the figures is an important one, but unless there is an accurate and skilled interpretation of these figures they mean but very little. The cost accountant is in a good position to make observations, which if based upon a sound knowledge of organization and familiarity with the outstanding problems of the company, should find many opportunities for making helpful suggestions and recommendations to the various officials. For example, where it is a practice to submit cost data to foremen, the cost department should make it a part of the cost job to give the foremen assistance in interpreting and drawing logical conclusions from the data submitted.

**Organization of the Cost Department.**—The cost department is under the direct supervision of the comptroller. The department is under the direction of a chief cost accountant who has immediate supervision of all its divisions. The work of these divisions must be closely coordinated in order to get the cost figures out on time. They must also work with the other divisions of the comptroller's department in the matter of statistics and reports.

**Cost of Operating the Cost Department.**—It is an easy matter to overman the department on the assumption that all the work performed is of value and therefore justifies the

expenditures. Its costs, as a rule, cannot be equitably distributed over the various departments receiving value through the use of figures and data supplied by it. The cost of operating the department is usually charged against manufacturing expense direct as a total sum. Although its value to the business as a whole is measurable, it may not be easy to appraise its worth to a particular operating department, and therefore it is difficult to apportion its costs.

The cost of operating the department consists mainly of supervision, clerical work, fixed charges, and printing and stationery. The cost of personnel is the only account of great importance in this department and the one which should receive most attention. In a previous chapter it was pointed out that the bad habit of collecting too many figures existed in many concerns. This practice will increase the expense of operating the department and also detract from the value of the work done by the department.

**Timekeeping as a Part of Cost.**—The function of this division is more or less self explanatory. It may be well to point out the reasons for placing the timekeeping division under the supervision of the cost department as it is not the general practice. As a rule, this plan results in greater accuracy of timekeeping, although theoretically any other plan should provide the same degree of accuracy. It permits greater cooperation with payroll and cost divisions and removes to some extent the possibility of undue influence being brought to bear by persons in the shop and elsewhere.

**Social Security.**—The recent legislation regarding old age pensions and unemployment insurance has added another factor to industrial costs. It seems that this factor is a part of cost, it is based on the amount of the payroll, and this can be distributed equitably to all departments on the basis of their payroll.

**Control of Factory Administration Departments.**—The various divisions of factory administration have been discussed largely from the standpoint of the accounts to be found in these

departments rather than from the standpoint of the work performed by them and their importance to the operation of the plant. Too much detail would have been required to set forth the innumerable ways in which an analysis of the accounts in each of these departments would be of value in planning and controlling operations.

The more important effects of costs and the major conditions and value of the analysis have been briefly mentioned. A thorough analysis of the costs of each of these departments should be made periodically. Only in this way can the full effects of the department's operations be checked and controlled. They are regarded as service units, and they should be so organized as to yield the greatest service. If the costs are controlled and frequent analysis made to determine the value of the work performed, the maximum amount of services should be obtained from the operation of these activities.

## CHAPTER 24

### CONTROL OF TRAFFIC DEPARTMENT COSTS

The term traffic in the business sense refers to the transportation of goods by rail, water, highway, pipe line, and air. Thus, the traffic department of an industrial organization is recognized as a separate function dealing with this specialized activity of transportation. As a general rule, it concerns itself entirely with external transportation although in some establishments the traffic department is also responsible for internal transportation or material handling. For the most part, the material handling activity or intra-plant transportation is a function of the production control unit, and is thus considered a separate and distinct activity from the traffic department. The work of a centralized traffic department embodies two major phases, that of inbound and that of outbound shipments; both are highly specialized activities and from the standpoint of costs, require analytical study of the records and work involved.

**The Importance of Transportation.**—The importance of transportation in our economic structure is clearly indicated by the fact that industry is dependent upon the rail, water, and highway agencies of transport to provide the services needed in assembling the raw materials, machinery, equipment, and other commodities used in productive enterprises and for distributing their products over the civilized world. The natural resources and the population of any country are generally scattered over the geographical limits of that country. It is not always economical or possible to locate the fabricating industry where resources abound. Similarly, it is not always best to locate it in the center of consumer population. Many factors are to be considered in selecting the most economical location and without the provision for adequate transport service for both “in-

coming" and "outgoing" commodities the choice of location as well as the size and character of the industry would be greatly restricted.

The question of rates, regulations, and service has in the past been responsible for bitter strife between industry and the transportation companies. They did not realize then as they do now, the interdependence of their interests. It is problematical how long the strife might have continued if the Federal and State governments had not recognized the necessity for ending the economic waste caused by this struggle through adjusting under legal authority the relationships of each to the other. Naturally this process of adjustment is not complete but it has reached the point where industry realized that in order to get adequate transport service, it must be prepared to pay a reasonable rate. The carriers have realized that in order to utilize their facilities and earn a sufficient return to attract new capital, they must equip themselves to render prompt and efficient service at reasonable cost. Thus, both have come to understand that their interests are mutual and that in order for either to make satisfactory progress, the other must also profit.

The importance of transportation to the average manufacturing industry is well illustrated by considering the proportion of the market value of a product which represents the cost of transportation. There are many cases in which 25% of the market value of the commodity represents transportation costs; in the case of coal, it frequently happens that the cost of transportation equals the price of the coal at the mine and in many cases it is two or three times more than the actual cost of the coal. The efficient conduct of business depends to a great extent upon adequate transportation facilities and service. Where raw materials cannot be secured due to transportation conditions, interruptions occur to production. Also, where deliveries of finished goods cannot be made to customers, orders may be cancelled and business lost.

With the development of modern business, a need has manifested itself for a more speedy and flexible means of transporting commodities over short distances. The introduction of the

motor truck has, to a great extent, solved this problem of the short haul and quick service deliveries in small lots.

In general, the economy of motor truck transportation is confined to distances of 150 miles or less, but in frequent cases the use of a motor truck accomplishes savings in transportation costs in distances of as much as 250 miles.

The introduction of the motor truck has emphasized the need for a well-organized traffic department. Unless the operation of motor trucks is carefully planned, scheduled, and supervised, much of the economy and advantage of their use is offset by excessive costs of operation, upkeep, and maintenance. Many of our leading railroads have inaugurated the motor truck pick-up and delivery system for less than carload lots; this has greatly facilitated transportation and aided the manufacturer, by reducing his cost of truck operations.

**Need for Industrial Traffic Management.**—Operating delays caused by failure to get prompt delivery of raw material, supplies, or machinery; broken delivery promises, cancellation of sales orders, and loss of good-will through failure to make deliveries of finished goods on schedule; purchases of raw materials in local markets at retail prices; upsetting production schedules and plans; finish orders delayed by a breakdown in transport service, and many similar problems are of everyday occurrence in most industrial concerns. They arise most times as a result of one or all of three primary conditions.

1. Failure on the part of the management to recognize the importance and far-reaching effects of transportation service.
2. Placing the responsibility for traffic work on the shoulders of an executive who has too much other work to do, or is not qualified for it.
3. False economy in operating the traffic department by employing inexperienced personnel.

The transportation agencies welcome the industrial traffic management. They see clearly how the traffic manager with his expert knowledge of their problems and his understanding of

the specific needs of his company can work advantageously with them in providing better service to shippers and at the same time in the more complete and profitable utilization of their facilities. Most carriers do not deliberately ignore the interests of their customers, but their own problems and work are so great that they do not have time to consider them as carefully as would be necessary if the maximum of service is to be rendered. The good traffic manager can talk the language of the carrier, can make the shippers needs understood, and can relate them to the carriers problems and their ability to meet them.

The enterprise that is interested in securing the most favorable rates and best transport service finds traffic management almost essential to satisfactory operation. From the viewpoint of management, the work of the traffic department should be centralized in the hands of an expert who is responsible for buying for that concern the right amount, kind and quality of transportation service required, and for securing it at reasonable rates. The task of keeping up with ruling and changes in regulations by carriers and regulatory commissions, maintaining files of tariffs, protesting rate changes, petitioning for special consideration in rate making, seeing that requirements are complied with in packing, shipping, and billing; the routing, and rating of "outgoing" shipments; and the auditing all transportation bills, are more effectively handled under centralized control. Moreover, the economies affected in operating costs and the inconveniences which are avoided by the introduction of traffic management are but additional evidences of the need for centralized control of traffic functions. Thus, the traffic department has taken its place among the primary activities in most concerns.

**Functions of the Traffic Department.**—The nature of the business and its place in the organization will determine to some extent the exact functions assigned to the traffic department. In some concerns it is responsible for internal transportation, shipping, motor truck operation, and for the usual duties connected with rates, routing, packing, billing, handling claims, and auditing transportation charges.

From an organization viewpoint, it appears to be a better practice to place internal transportation under the control of some other center, possibly production management, and to vest the line control of shipping in the sales department, or to place it under the head of finished stores. Unquestionably, the traffic department should exercise functional control over the shipping department since many of the benefits of expert traffic knowledge will not be secured if it is not applied to the shipping activity. The function of receiving may be a part of the function of purchasing or storeskeeping instead of traffic. The above illustration indicates how functions assigned to the traffic department may vary in different concerns depending upon their particular needs. The following list is, therefore, not intended to be inclusive, but merely representative of those functions usually assigned to a well-organized traffic department in a fairly large business concern.

1. To select the best and cheapest method of transportation.
2. To determine the fastest routes and means of transportation to meet requirements.
3. To audit all transportation bills.
4. To prepare, file, and handle all claims for overcharge, loss, and damage. (In 1935 the Class I Railroads paid \$17,350,903 for loss and damage of freight.)
5. To obtain and quote rates.
6. To prepare data and to represent the company in rate hearings before regulatory bodies.
7. To maintain and supervise adequate traffic files.
8. To determine the routing for incoming and outgoing shipments where not specified by vendor or purchaser.
9. To trace and expedite the movement of all inbound and outbound shipments when necessary.
10. To procure cars for shipments and to handle car service charges.
11. To prepare all packing and shipping instructions.
12. To functionally control the packing, boxing, crating, marking, and billing of freight.
13. To recommend the various types of satisfactory containers for shipping purposes.



14. To direct and control motor truck transportation.
15. To cooperate with other departments.
16. To assist the management in the selection of warehouse, office, and plant locations.
17. To make recommendations as to shipping facilities, equipment, and methods.

Several other important functions might be properly added to this list depending upon the scope of the department's activity.

**Place of Traffic Department in the Organization.**—In most cases, the work of the traffic department is concerned primarily with rendering service to those agencies responsible for the supply and distribution activities of the business. The rule followed in organization practice is to place a complementary or service function under that activity which it serves. The exception to this practice is when the complementary function does not serve one activity more than another or is of sufficient importance to justify giving it a major place in the operating organization. Thus, if the traffic department is designed primarily to serve the material supply or purchasing activity, it should be controlled by that activity. Similarly, if it serves the distribution or sales activity, it should be controlled by that activity. In cases where the service rendered is equally distributed between these activities, the control of traffic should be vested in the executive who serves as a coordinator of the procurement and distribution activities. In most instances, this would be the general manager. This is probably the plan most widely followed because its administration can be more easily related to the activities it serves.

**Organization of the Department.**—The size and extent of the traffic department organization will depend in part upon the nature of the enterprise, the character of the traffic to be handled, the volume of business, the policy of the company governing branch organization, warehousing and importing or exporting, and the general organization policy of the concern. The traffic department renders service to all branches of the

business, and may be properly controlled through purchasing, sales, or general management. In remote cases where the work of the department is largely of a clerical nature, such as making out shipping papers, the traffic department functions under the office manager. The major work of the department is to render service to the purchasing and sales departments, and it should, therefore, be so organized as to meet the demands made upon it by these departments. In the larger companies the department usually consists of three major divisions:

1. Rail and Water Division
2. Motor Truck Division
3. Clerical Division

The chart shown in Figure 35 will convey graphically the relation of the traffic department to the business as a whole.

**The Traffic Manager.**—The work of the department is under the control of the traffic manager who reports to the general manager, except under such circumstances as described in the preceding paragraph. The executive who is responsible for the direction and control of traffic service must possess a combination of qualities not easily found or developed. He must have a thorough knowledge of the principles and structure of rate making; he must be able to interpret and apply tariffs and regulations applicable to the particular freight and its movement; he must be well informed as to the rulings of the various regulatory commissions and the freight classifications in order to prevent the traffic of his company from bearing excessive rates.

He must be accurately informed of the rules of all carriers and commissions regarding the packing, boxing, marking, loading, and billing of freight; he must possess a sound knowledge of the business and its finished products and the raw materials used in their fabrications, as a means of applying and observing these rules and regulations.

He should be thoroughly familiar with the location, character, and extent of the railroads, highways, and waterways of the country as a basis for the routing of incoming and outgoing

shipments; he must know the method and procedure in filing claims, presenting causes before the various commissions, and the legal liability of carrier and shipper in the movement of

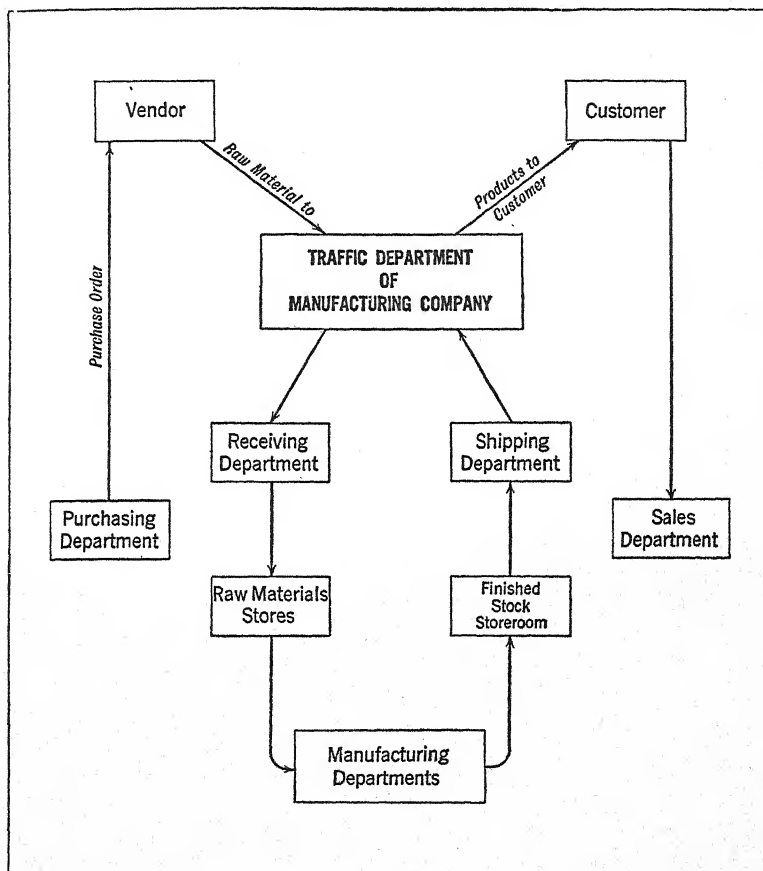


Figure 35. Chart Showing Relation of Traffic Department to the Business as a Whole

traffic. In addition to this technical knowledge, he must possess those executive qualities necessary to the conduct of his function.

**Waste in Traffic Activities.**—There are innumerable ways in which waste may occur in traffic activities which naturally will greatly increase the costs of operation.

1. Improper and careless packing of the goods in the shipping unit and in the railroad car or motor truck may result in serious damage during transit.
2. Inefficient marking of the cases or goods by the shipping unit may cause the traffic unit a great deal of trouble and expense.
3. Incomplete or inaccurate shipping specifications and incomplete description of merchandise may result in the payment of higher shipping rates.
4. Incomplete shipments of goods ; parts, or materials omitted.
5. Poor choice of routes. If the cheapest and best routes are not selected for traffic movement, delays will be more frequent and shipping costs may be greatly increased.
6. Company truck transportation must be carefully watched, or loss will occur. For instance, utilizing heavy trucks for light work, incorrect scheduling and routing of trucks, goods not loaded in proper sequence, and the many wastes in connection with truck operation and maintenance.
7. Idle time of equipment, abuse of equipment, excess help, accidents, damage to merchandise and materials, and incomplete or inadequate records, are common forms of waste in traffic activities.

### **Fundamentals of the Costs of Transportation.**—

#### **TANGIBLE COSTS**

*The materials or goods to be transported.*

1. Nature, space occupied, weight, quantity and value—all of these factors influence costs.
2. Distance—as a general rule, cost increases as distance of travel increases.
3. Speed—as a general rule, the cost increases as the speed of transportation increases.
4. Type of transportation—rail, water, truck, pipe line,

and air. Costs vary depending upon type of transportation.

5. Handling—the greater the number of times the materials or goods are handled, the greater the cost of transportation.

#### INTANGIBLE COST

1. *Service.* The quality of service rendered by the carrier or the company's truck have a decided effect on costs, in terms of promptness, reliability of delivery, and care in handling the goods.

**Motor Truck Transportation.**—The desirability and economy of motor truck transportation for short haul business is well substantiated by the increase in the number of trucks registered in the United States. In 1916, there were 215,000 trucks registered, while in 1935, the registration had increased to 3,655,705<sup>1</sup> trucks. Most concerns operate at least one truck while many organizations operate a fleet of trucks.

**The Motor Truck Division.**—Many common carriers have undertaken the operation of a fleet of motor trucks as a supplementary means of transporting freight in less than carload lots, and in connection with the pick-up and deliver system lately inaugurated. As a rule, they do not use trucks except where the haul is short or where it is a greater convenience from the standpoint of handling the freight. In some sparsely settled localities where they wish to maintain service, trucks are found to be more economical than rail operation. In a few instances, where there are no rail facilities available, truck hauling service is provided until such time as the volume of traffic warrant the building of rail line. The greatest use of motor truck fleets by industrial concerns is for the pick-up and delivery of goods or materials within a short radius from the plant. There are, of course, a great many trucking companies offering a public trucking service for both short and long hauls. At present they are not as highly regulated as other common carriers and their rates vary considerably. Many con-

<sup>1</sup> Year book of Railroad Information, 1936.

cerns contract with an outside trucking company for whatever service they may need. In some cases this is more economical than owning and operating a fleet of trucks and in other cases, the plan is used because of the location of the business, lack of space for truck garages and repair shops, or where the volume of freight to be handled is not sufficient to warrant the operation of a fleet.

**Organization of the Motor Truck Division.**—In the larger concerns, the motor truck division is a part of the traffic department and under the control of the traffic manager. In some cases, it is a separate organization unit controlled by the purchasing or sales department. In some of the large retail stores the delivery department reports directly to the general manager or store superintendent.

Where the trucking service is extended to the manufacturing and marketing departments it appears to be desirable to make the activity a part of traffic management and to create a separate division to handle truck operation. This plan provides for centralized executive control of the work, permits the development and use of specially trained personnel, and makes it possible to coordinate trucking with other division of traffic work more effectively.

**Accounting Treatment of Traffic Department Costs.**—The usual method of accounting for traffic costs is to establish and maintain the necessary accounts, based on an adequate classification and distribute the total costs to the purchasing and sales departments according to the respective services rendered to each. In some cases, traffic department expense is handled similarly to shipping expense and is deducted in total on the profit and loss statement. Frequently the traffic department renders slight service to general and factory administration by purchasing rail and steamer accommodations for executives and making reservations of various kinds. This service is so slight that as a rule no attempt is made to make a specific charge against administration.

To permit a detailed analysis of the costs of operating the traffic department, it is necessary to have detailed information relating to each phase of traffic activity. This information is usually secured through the use of a general classification of accounts. A typical classification of traffic department accounts is shown below. It is not all inclusive, but such additional accounts as are required in a particular case may be easily added. If more detailed information is required than is provided by this classification, it is a relatively easy matter to establish a subclassification which will give this information.

**Classification of Traffic Department Expenses.—**

- Supervision
- Clerks
- Stenographers
- Office Supplies
- Printing and Stationery
- Telephone and Cable
- Light, Heat, and Water
- Truck Drivers and Chauffeurs
- Laborers
- Demurrage
- Maintenance of Trucks
- Maintenance of Buildings
- Expense Tools and Supplies
- Gasoline
- Oils and Lubricants
- Fixed Charges

Most of these accounts have been analyzed in previous chapters, and it is unnecessary to discuss them again. There are a few accounts in the traffic department which are peculiar to it and their analysis must be made in the light of the work accomplished.

**Motor Truck Maintenance.**—A discussion of the cost of maintaining motor trucks would be much the same as the previous discussions of maintenance of machinery. However, the cost of motor truck maintenance must be analyzed in the light


TRUCK OPERATING COSTS							
Month of January, 19..							
NAME	Truck No. 1 5 Ton Gas	Truck No. 2 5 Ton Gas	Truck No. 3 2 Ton Gas	Truck No. 4 2 Ton Gas	Truck No. 5 2 Ton Gas	Truck No. 6 Electric	Total
<b>DIRECT OPERATING COSTS</b>							
Truck Drivers							
Helpers							
Maintenance Labor							
Maintenance Material							
New Parts							
Tires							
Gasoline							
Electricity							
Oils & Lubricants							
Insurance							
License Fees							
Taxes							
Depreciation							
<b>TOTAL</b>							
<b>INDIRECT OPERATING COSTS</b>							
Supervision							
Office Expenses							
Rent							
Light							
Heat							
Water							
<b>TOTAL</b>							
<b>TOTAL OPERATING COSTS</b>							
Miles Traveled							
Tonnage Carried							
Operating Time							
Gasoline Consumed							
K. W. H. Consumed							
Oil Consumed							
Original Cost of Truck							
Cost of Operation Per Hour							
Hours Down for Repairs							

Figure 36. Monthly Truck Operating Costs

of truck performance, load carried, age of truck, time, operating conditions, and mileage. Figure 36 is a representative form for compiling monthly truck operating costs.



**Statistical Information Needed.**—The control of motor truck operation cannot be adequately maintained without compiling and using various statistical data of truck operations.

  
**OPERATION & MAINTENANCE**  
 Standard Cost System

**Driver's Route Card**

Vehicle No. \_\_\_\_\_ Date \_\_\_\_\_ 192\_\_  
 Driver \_\_\_\_\_ Left Garage \_\_\_\_\_  
 Route No. \_\_\_\_\_ Returned \_\_\_\_\_

**TRIP LOG**

From	To	Tons, Stops or Pkgs.				Miles	Time	
		Out	Del.	Pick-ups	In		Out	In
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
<b>Totals</b>								

**SUPPLIES**  
 Gal. Gas. \_\_\_\_\_  
 Kw.-hr. Current \_\_\_\_\_  
 Qts. Oil \_\_\_\_\_  
 Lbs. Grease \_\_\_\_\_  
 Qts. Kerosene \_\_\_\_\_  
 Lbs. Waste \_\_\_\_\_

**WORKERS' TIME**  
 Driver \_\_\_\_\_  
 Helper(s) \_\_\_\_\_  
 Washer \_\_\_\_\_  
 Mechanic(s) \_\_\_\_\_

**MISCELLANEOUS**  
 Loading Delays \_\_\_\_\_  
 Traffic Delays \_\_\_\_\_  
 Accidents \_\_\_\_\_

O.K. \_\_\_\_\_

Superintendent \_\_\_\_\_

Figure 37a. Driver's Route Card (Face)

There are much data of interest and value which the accounting classification will not reveal. For example: The cost of truck operation per ton mile of merchandise carried, the consumption of gas and oil per ton mile of truck operation, cost of repairs and maintenance per ton mile, and operating cost per hour or per trip.

**Monthly Truck Operating Costs.**—A good illustration of the wealth of statistical and cost information which may be secured to assist in the control motor truck operation is found


<div style="text-align: center;">   <b>OPERATION &amp; MAINTENANCE</b>            Standard Cost System  <b>Driver's Mechanical Report</b>            Check each part on this list. Repairmen will correct all troubles reported hereon         </div>		
<b>MOTOR</b>	<b>MISCELLANEOUS</b>	
Ignition _____	Wheels _____	
Carburetor _____	Springs _____	
Cooling _____	Frame _____	
Lubrication _____	Radius Rods _____	
Valves _____	Torque Arm _____	
Governor _____	Radiator _____	
Power _____	Fan _____	
Knock _____	Fan Belt _____	
Compression _____	Battery _____	
Missing _____	Controller (Elec. Veh.) _____	
	Motor Controls _____	
	Pedals _____	
<b>TRANSMISSION</b>		
Clutch _____	Lever _____	
Gearbox _____	Vacuum System _____	
Universals _____	Windshield _____	
Jackshaft _____	Lamps _____	
Differential _____	Speedometer _____	
Chains _____	Fenders _____	
	Cab _____	
	Body _____	
<b>BRAKES</b>	<b>TIRES</b>	<b>Odometer Reading</b>
Foot Brakes _____	Left, front _____	
Hand Brakes _____	Right, front _____	
	Left, rear _____	
<b>STEERING GEAR</b>	Right, rear _____	
Gears _____		
Tie-Rods _____		
Front Axle _____		
Key: /—Performance O.K. A—Adjust. R—Repair Repairs and Adjustments made, O.K. _____		

Figure 37b. (Reverse)

in Figures 37a and b, which comprise a part of the "Operation and Maintenance Cost System" copyrighted by the Chilton Class Journal Company of Philadelphia, Pa., and reprinted here with their permission.

**The Driver's Route Card.**—The driver's route card (Figure 37a) is given to the truck driver each day at the time he leaves the garage. The garage manager writes in the time of departure from the garage. All other information on this card is filled in by the driver at appropriate times. When the driver returns the truck to the garage, the garage manager notes on the card the time of return. The driver then makes out the mechanical report shown on the reverse side of this card (Figure 37b) and leaves the card in his truck. The garage mechanic examines this card and makes the necessary repairs, and the garage attendant supplies the truck with oil, gas, and grease, the amounts of which are noted on the card in the proper spaces. The following morning, the driver receives a new card and the old one is turned in to the cost office. Cards for each truck are accumulated for the month, at which time they are summarized and the information transferred to the monthly cost summary sheet (Figures 38a and b).

**Monthly Cost Summary Sheet.**—From this monthly cost summary sheet, not only the cost of maintenance and operation may be obtained, but also various statistical data. The methods of computing various items are explained on the sheet. The value of such information in comparing the cost of operating and maintaining different makes of trucks doing similar work; determining trip mileage of trucks and the special value of trucks for particular classes of uses can be readily obtained. Much additional statistical information may be secured from such a form.

**Difficulty in Obtaining Reports.**—The more usual type of truck driver and garage mechanic is not especially concerned with the cost of motor truck operation, and is much less interested in cooperating with the cost department in making out the various forms required. The possibilities of getting the cooperation of drivers and mechanics is much greater if the form is simple, easily understood, and requires but little of their time to prepare. It is important, therefore, that these factors be considered in the development and technique of the cost system for motor truck operation.

<b>Operation &amp; Maintenance</b>		<b>Standard Cost System</b> <small>(COPYRIGHTED)</small>	<b>MONTHLY COST SUMMARY SHEETS</b>
Month ending _____ 19____			
Make of Truck _____	<div style="display: flex; align-items: center;"> <div style="border-left: 1px solid black; padding-left: 5px; margin-right: 5px;">             Gasoline Electric           </div> </div>		
Complete system — 500 drivers' daily route cards, 60 monthly summary sheets, information booklets, and a Trussell ring binder — costs postpaid, \$9.50 Address CHILTON CLASS JOURNAL COMPANY, Chestnut and 56th Streets, Philadelphia, Pa. Publishers COMMERCIAL CAR JOURNAL and OPERATION & MAINTENANCE			
<b>Operating Charges</b>			
Gasoline _____ gals.	@ _____	\$ _____	
Current _____ kw-h.	@ _____		
_____	@ _____		
Oil _____ qts.	@ _____		
Grease _____ lbs.	@ _____		
Kerosene _____ gals.	@ _____		
Waste _____ lbs.	@ _____		
Dist. Water _____ gals.	@ _____		
_____	@ _____		
_____	@ _____		
Driver _____ days	@ _____		
Helper _____ days	@ _____		
_____	@ _____		
_____	@ _____		
Mechanic _____ hrs.	@ _____		
<b>A—Total Operating Charges</b> .....			\$ _____
<b>Maintenance Charges</b>			
*Tires _____ miles	@ _____	\$ _____	
Repairs .....			
Overhauling, painting, etc. ....			
Spare vehicle rental .....			
Garage rental (pro rata) .....			
<b>B—Total Maintenance Charges</b> .....			\$ _____
<b>Fixed Charges</b>			
Insurance, fire @ _____	per year	\$ _____	
Liability @ _____	per year		
Collision @ _____	per year		
Interest @ _____	% (On Item 1 ÷ 12)		
Depreciation on chassis @ _____	%		
Depreciation on body @ _____	%		
Depreciation on equipment @ _____	%		
*Depreciation on tires @ _____	%		
Total taxes and licenses .....			
<b>C—Total Fixed Charges</b> .....			\$ _____
*Note: Omit one of these.			

Figure 38a. Monthly Cost Summary Sheet for Truck Operation and Maintenance (Face)

# Operation & Maintenance Standard Cost System

(COPYRIGHTED)

## MONTHLY COST SUMMARY SHEETS

Number of Truck \_\_\_\_\_

Capacity in lbs. \_\_\_\_\_ Chassis No. \_\_\_\_\_

Complete system—500 drivers' daily route cards, 60 monthly summary sheets, information booklets, and a Truesell ring binder—costs postpaid, \$2.50  
 Address: CHILTON CLASS JOURNAL COMPANY, Chermest and 56th Streets, Philadelphia, Pa.  
 Publishers COMMERCIAL CAR JOURNAL and OPERATION & MAINTENANCE

### Investment

Cost of chassis, less tires.....	\$		
Cost of body.....			
Cost of equipment.....			
Cost of tires.....			
1—Total cost, complete.....	\$		

### Performance Record

2—Days operated.....	_____
3—Days idle.....	_____
4—Days maintained (Item 2 ÷ Item 3).....	_____
5—Total hours operated.....	_____
6—Total miles covered.....	_____
7—Total trips made.....	_____
8—Total tons or packages or stops.....	_____

### Performance Averages

9—Average miles per day maintained (Item 6 ÷ Item 4).....	_____
10—Average miles per day operated (Item 6 ÷ Item 2).....	_____
11—Average miles per trip (Item 6 ÷ Item 7).....	_____
12—Average tons, stops or packages per trip (Item 8 ÷ Item 7).....	_____
13—Average commercial ton miles, package miles or stop-miles per trip	$\frac{\text{Item 11} \times \text{Item 12}}{2}$ _____

### Recapitulation

14—Total expenses for month (Sum of Items A, B and C).....	\$ _____
15—Cost per day operated (Item 14 ÷ Item 2).....	_____
16—Cost per day maintained (Item 14 ÷ Item 4).....	_____
17—Cost per mile operated (Item 14 ÷ Item 6).....	_____
18—Total commercial ton-miles, package-miles or stop-miles (Item 7 × Item 13).....	_____
19—Cost per commercial ton-mile, package-mile or stop-mile (Item 14 ÷ Item 18).....	\$ _____

Figure 38b. (Reverse)

**Analysis of Traffic Department Office Expense.**—In conjunction with the analysis of certain of the other phases of traffic department operation, it is essential to have statistical data relating to the work. For example, the analysis of the costs of operating the office shows but little in connection with the work of auditing, filing, and following up claims for losses, damage, or overcharge. Claims must be analyzed according to causes to determine if the underlying reasons for such claims are within the control of the traffic activity, or if not, what steps may be taken to bring them under control. For example, an analysis of claims made by the traffic department of an electrical manufacturing concern revealed the fact that almost 75% of them were due to damage and breakage of one particular product. A careful check-up of the packing instructions and packing materials used in preparing this product for shipment was made by the traffic department. This disclosed that the real reason for the large number of claims was due to lack of strict adherence to packing instructions and the use of an inferior quality of packing materials. In a furniture factory, the lack of standard descriptions for products shipped resulted in greatly increased freight rates and many claims for overcharges.

**Value of Analysis of Traffic Department Costs.**—The value of prompt service in securing empty cars and in having incoming carload shipments placed where they are to be unloaded will not be shown in the accounts of the traffic department. The ability to secure empty cars when needed oftentimes makes a difference in collections and the customer's attitude. Likewise, the promptness with which empty cars are loaded or incoming shipments are unloaded may save demurrage charges. The traffic department, although not responsible for the unloading of cars, must see that the freight bills are promptly obtained and that cars are placed in position to be unloaded and that the material handling department is notified so that the unloading may be done without delay.

There are other ways in which the traffic department may be helpful to various departments of the concern and effect

both direct and indirect savings of money. Therefore, it is necessary for the analysis to consider these points in connection with fluctuating and apparently excessive costs of operating the department. The follow-up of incoming and outgoing shipments of materials or finished products may indirectly save money through preventing interruptions to production, preventing cancellations of orders, loss of discounts, or changes in financial plans, due to delayed or loss of inbound or outbound shipments.

There has been but little done in the field of cost accounting for motor truck and traffic department operation. The importance of the work to an industrial concern, the money which may be spent in motor truck operation, the delays, trouble, and losses which may occur through lack of adequate traffic service all combine to make the work of the department highly important and the necessity for cost control very urgent.

## CHAPTER 25

### MARKETING COSTS

**Control of Marketing Operations.**—The marketing process includes all work involved in passing the finished product from the manufacturer or producer to the ultimate consumer. This work or process includes the determination of marketing policies, the selection of the channels of distribution, selection and training of salesmen, actual selling of the goods, advertising and sales promotion, and the direction and control of all selling activities.

The general sales manager is responsible for the control of all sales operations, which is fundamentally based on the following managerial requirements:

1. Organization of the marketing function.
2. Market research and market forecasting.
3. Adequate records of marketing operations.
4. Development of a marketing program.
5. Establishment of effective marketing policies.
6. Planning the work of the marketing function.
7. Effective direction and control of advertising.
8. Analysis and comparisons of the costs to sell.
9. Coordination of sales and production.

**1. Organization of the Sales Function.**—The activities of marketing will vary according to the nature and characteristics of the goods for sale, and consequently the organization for marketing will vary according to these factors and the type and size of the business.

As the manufacturing concern is more or less representative of general business practice, it is considered advisable to discuss the organization of this type of sales function.

The sales function is a major activity of business and as such it is usually established as a separate department under the



supervision of a general sales manager who reports to the general manager directly. The sales function is subdivided into such divisions as are deemed necessary for the proper carrying out of the work involved in this activity.

The usual organization of the sales department consists of the following divisions:

- Domestic Sales
- Foreign Sales
- Research
- Sales Engineering and Service
- Advertising and Sales Promotion
- Selling Records and Statistics
- Shipping

Each of these activities is headed up by a specialist in the particular field, and report directly to the general sales manager.

In concerns operating warehousing facilities the activity is included in the sales function and in some instances the traffic function is also a part of the sales organization.

**2. Market Research and Market Forecasting.**—The manufacturer of consumers' goods can seldom escape the necessity for careful market research, which is a continuous necessity throughout the entire life of a manufacturing enterprise. There is on the one hand, a need for periodic but intensive surveys of special problems. Market data is necessary:

1. To provide the basic factual information upon which fundamental marketing policies may be formulated.
2. To provide basic factual information upon which specific marketing campaigns may be built.
3. To provide data for the analysis and evaluation of the effectiveness and economy of specific marketing methods and operations.
4. To assemble the necessary statistical data and opinion which may be essential to accurate market forecasting.
5. To provide for the analysis and interpretations of costs of marketing.

The whole range of marketing policies concerning the product line, prices, trade-channels, dealers and customers should be based upon factual information which is both comprehensive in extent and accurate in individual details. In formulating marketing policies executives must realize that customers' demands are the origins of economic impulses and that these customers' demands are dynamic and changing. Research must gather all the essential quantitative facts with respect to the number, geographic distribution, and economic status of present and potential customers. In addition, it must gather qualitative data concerning the preferences, habits, customs, buying motives, and resistances or prejudices of customers and prospects. Both types of information are necessary because willingness to buy is just as important to the manufacturer or distributor as is ability to buy. It is the sheerest folly to formulate market policies without rooting the policies in complete and accurate market data.

Market research should also be used to suggest the selling machinery and methodology necessary to realize upon market possibilities. Time and effort must be given to the all-important task of planning specific marketing campaigns; the test of building sales machinery and methodology in direct relation to particular market requirements. The wastefulness of "blind" or "hunch" planning should be entirely obvious. Campaigns should not be shot wildly into the air. They need to be aimed at accurately-determined market conditions. Entirely apart from the task of gathering basic information upon which market policies or specific marketing campaigns can be set up, the market research department should devote considerable time and effort to economy investigations and to the study of individual bits of market methodology. Sales operations need to be broken down into their basic elements by a species of time study. Averages of sales results need to be worked out. Standards of sales operations need to be set up. Accomplishments need to be checked against standards. All down the line of personal selling activities—number of sales calls, prospecting, missionary work, and so on,—methods need to be studied and evaluated. Ineffective methods and useless and unnecessary

operations will hardly be scrapped until these methods and operations are shown to be wasteful by research and analysis.

In the same way the advertising methodology of copy, illustration, typography, size of unit space, media, and so on, needs to be tested periodically by persistent and relentless research.

Finally, market research may be called upon to devote a part of its time to the collection and compilation of per capita consumption by territories, automotive registrations, income tax returns, and other statistical data that may be of use in connection with market forecasting. After the market forecasting personnel has decided upon necessary market indices and their combination, the type of information desired can be pretty well standardized. Then, if market research is charged with the responsibility of collecting and tabulating this information as is usually the case, this particular task can be reduced to routine work.

**3. Adequate Records of Marketing Operations.**—The control of marketing operations and cost of marketing is dependent on accurate and adequate records of each phase of marketing operations. Certain sales information can be obtained from the accounting records, such as the accounts receivable, analysis of sales by commodities, and cost of sales, but other records and sales statistics should be maintained by the sales organization.

**4. Development of a Marketing Program.**—Business operations are conditioned by the volume of sales. Whether it be commodities or services, each individual activity within the business depends upon volume to be produced and that volume is, of course, dependent on sales. Therefore, it is absolutely necessary to develop a marketing program to guide management in the economic conduct of the business. The most effective means of developing such a program is through marketing research and the preparation of the estimated anticipated sales for future periods.

Thus, a scientific economical sales program should be based on the following factors:

- (a) Market research
- (b) Sales forecasts
- (c) Financial capacity
- (d) Marketing policies
- (e) Sales budget
- (f) Coordination of all activities of the business

**5. Establishment of Effective Marketing Policies.**—A market policy is a line or course of action predetermined for the purpose of insuring uniformity and consistency of procedure over a period time under essentially similar and recurrent circumstances.<sup>1</sup>

A policy is not the same as a principle or as a plan. A principle is a fundamental and settled line of right action. A plan implies scheduling as well as laying out work to be done. A policy may be faulty because it is unsound in principle. A business enterprise may formulate excellent marketing policies and yet falter and even fail because of an ineffective planning of market operations. The purpose for any policy, marketing or otherwise, is to insure a uniform and consistent course of action that is based upon such careful research as would scarcely be possible if each case was to be considered individually. Policies such as price, quality, discount, trade channels, warehousing, etc.

**6. Planning the Work of the Marketing Function.**—Definite plans should be made to accomplish the work laid down in the marketing program. Planning, in this case, consists of two major phases—(a) internal planning and (b) external planning.

- (a) The internal planning deals with the internal activities of the sales department, such as planning the
  - 1. Internal Organization of the department to take care of each phase of the work.
  - 2. Necessary records.
  - 3. Type and method of packing and shipping.
  - 4. Personnel requirements.

---

<sup>1</sup> Dr. G. R. Collins.

5. Type, method, and class of advertising, and all other activities necessary to carry out the marketing objective.

(b) The external planning covers the preparation of plans, such as:

1. Methods for dealing with customers.
2. Planning sales territories.
3. Locating of branch offices and warehousing facilities and all other necessary external activities.

**7. Effective Direction and Control of Advertising.**—Each phase of advertising must be controlled and kept within its requisite appropriation. The costs of advertising must be measured in terms of results obtained and analyzed to determine variations from set standards. All variations must be further analyzed to determine cause. The control of advertising costs will not be effective, unless advertising and sales programs are closely coordinated. (See Chapter 27.)

**8. Analyses and Comparisons of the Costs to Sell.**—Unquestionably, one of the most important tasks of marketing management today is the effective control and possible reduction of marketing costs. And this problem of costs is just as often a matter of wasteful routine methods as it is the result of vaguely defined campaign objectives, "hunch" planning, and illogical general market policies. Each part of the marketing fabric needs to be taken apart and gauged, not with hardened steel gauges, perhaps, but by persistent analysis, classification, and measurement.<sup>2</sup>

Research must be required to contribute its efforts in reducing the costs marketing methodology.

In analyzing the costs to sell there are many important factors which must be examined in conjunction with cost figures. Each of these factors may have a decided bearing on costs and may contribute largely to causes for cost variations or excessive costs. Such factors are:

---

<sup>2</sup> Taken from the works of Dean G. R. Collins, New York University.

1. THE PRODUCT: Does it meet customer's requirement?  
Does it need constant servicing?  
Are servicing facilities available?  
Is it difficult to ship?  
Can it be stored easily?  
Does it need constant inspection?  
What is its normal life?  
Is it guaranteed for any period?
2. SALES REPRESENTATIVES: Type of salesmen.  
Efficiency of selling force.  
Sales effort necessary.  
Training of salesmen.  
Methods of paying salesmen.  
Methods of selecting salesmen.
3. TERRITORIES: Nature, characteristics, and physical conditions of the territory.  
Number of salesmen in territory.  
Type of supervision.  
Distance salesmen are required to travel.  
Social and economic conditions within the territory.  
Potential sales.  
Location of customers and prospects.  
Farming and industrial areas.  
Past sales of the territory.  
Competition in territory.  
Methods of selling, wholesaler, retailer, or consumer.  
Warehousing facilities.  
Advertising methods and media.
4. MARKETING POLICIES: Selling policies, credit policies, consignment policies, discount policies, price policies, service policies, etc.  
Are they flexible? Do they meet their respective requirements?
5. CUSTOMERS: Type and class of customers.  
Financial rating.  
Location.  
Volume of business.  
Claims and adjustments.

Each of the above factors should be carefully analyzed to determine its bearing on costs and to find ways and means for reducing the costs produced by each of these factors.

It is also necessary to analyze such factors as:

1. Sales returns to determine the cause.
2. Accounts receivable
  - To determine new customers.
  - Good customers.
  - Bad customers.
  - Territories in which it does not pay to sell.
  - Products it does not pay to sell and customers to whom it does not pay to sell.
3. Methods of packaging, packing, shipping, and delivery to determine more economical practices to follow.

**Analyses of Marketing Costs.**—The costs to sell or sales expense should be accumulated, classified, and recorded monthly, then the figures should be carefully analyzed and compared with the established standards and the costs for the previous periods to determine variations and the causes.

**Cost Accounting for Sales.**—Cost accounting for sales is a relatively new development. For many years cost accounting has been used in connection with manufacturing activities and has rendered great benefits to the management in finding costs and in controlling expenses. There has been no physical reason for not applying similar principles and methods of cost accounting to sales and using the results in the same way and for similar purposes. The failure has been due to the inability of management to see the possibilities of cost accounting in relation to sales. Even now, there are a great number of concerns, perhaps the majority, which do not collect and analyze the costs of selling. Certain statistical tabulations may be made and examined, but a complete study of sales activities in relation to the cost of each phase of activity and the relation of costs of selling to products, profits, salesmen, territories, etc., are not considered.

**Accounting Treatment.**—The division of the sales function into its major phases of activity is of assistance in obtaining more definite managerial control and permits the assembling

of the selling costs for each division of activity. The major divisions of selling activity are:

- Selling
- Advertising
- Shipping

The selling division, from the cost accounting point of view, includes the expense of operating the home and branch sales offices, all salaries, and expenses of sales engineers.

The division of advertising includes the cost of all advertising and sales promotion and the costs of operating these offices.

The division of shipping should include the cost of packing material, labor, marking, making up the necessary shipping papers, and delivery of sold merchandise to customer's truck or the carrier, exclusive of cartage charges. Cartage is included in the traffic department expense, and charged to sales. The shipping activity is sometimes organized as a part of the traffic department.

Information relating to the total cost of the various divisions of sales activity mentioned above is seldom sufficient for the needs of management. It is necessary in securing cost control of these activities to have a more detailed knowledge of the various elements of expense which make up the total cost of operating each division. It is necessary, therefore, to establish a detailed accounting classification of sales expenses. From this classification, the management may build up cost and statistical data relating to any phase of sales activity, analyze and compare various elements of expense, and obtain a better control of the expenses represented by each account. The detailed accounting classification shown below is representative of the accounts to be found in the sales department of a manufacturing concern.

**Classification of Sales Expense.**—This classification is as follows:

- Salaries of Executives and Assistants
- Salaries of Salesmen
- Clerical



Stenographic	
Office Supplies	
Postage	
Printing and Stationery	
Telephone and Cable	
Traveling Expenses	
Entertainment	
Insurance	
Light, Heat, and Water	
Maintenance of Buildings	
Maintenance of Equipment	
Adjustments	
Dues and Subscriptions	
Demonstrations	
Education and Training	
Exhibits	
Automobile Expenses	
Commissions	
Bonuses	
Royalties	
Samples	
Sales Conventions	
Rent	
Advertising Printing	} See Chapter 27
Advertising Space	
Advertising Mechanical	
Shipping Labor	
Packing Materials	
Expense Tools and Supplies	
Material Handling	
Fixed Charges	

**Importance of Classification.**—The distribution sheet (Figure 39) shows how the expenses in the above classification may be distributed according to the division, branch, or other unit incurring the expense. Subclassification of certain of these accounts may be made to secure the detailed elements of ex-

pense entering into the particular account if such data are desired by management.

Information relating to the cost of selling by classes of product, territories, individual salesmen, etc., may be secured by constructing analysis sheets on which provisions are made for the prorating of certain items of expense which cannot be charged directly to a given class of product, salesmen, territory, etc. Where various products are sold by each salesman, varying rates of commission are paid on the different products, or straight salaries are paid instead of commissions, and both national and local advertising are carried on. An equitable rate for prorating these expenses against the different classes of products must be established. Such matters as the relation of bad debts to gross sales; sales by territories; cost of collection of delinquent accounts by territories; sales returns by products, salesmen, or territories, and much other valuable data, may be secured through statistical tabulations which can be compiled from the accounts and other records of the sales department.

**Benefits of Analyzing Selling Expense.**—Analysis of the selling expenses must be made if the volume of sales is to be balanced with the cost of selling. This is essential if the most economical operation of the sales department is to follow. Only through the analysis of the various items of selling costs, can management intelligently establish, check, and alter sales policies, determine the most profitable lines of product, determine the best methods for distributing the product, select the most economical channels of distribution, etc. The analysis will assist in determining what territories are non-productive, the character and extent of advertising needed, the effectiveness of salesmen and sales supervision, and the answers to many of the additional problems and questions of importance which arise in the operation of the sales department.

**Analysis of Sales Expense.**—As previously pointed out in this chapter, many of these accounts may be further subdivided if a more detailed analysis is desired. Likewise, many of these accounts have been discussed in previous chapters and

DISTRIBUTION OF SALES EXPENSE							
Month of January, 19..							
Name of Account	Main Office	Chicago Branch	Detroit Branch	Atlanta Branch	Advertising Division	Shipping Division	Totals
Salaries of Executives and Assts.							
Salaries of Salesmen							
Clerical							
Stenographic							
Office Supplies							
Postage							
Printing and Stationery							
Telephone and Cable							
Traveling Expense							
Entertainment							
Insurance							
Light, Heat, and Water							
Maint. of Buildings							
Maint. of Equipment							
Adjustments							
Dues and Subscriptions							
Demonstrations							
Education and Training							
Exhibits							
Automobile Expense							
Commissions							
Bonuses							
Royalties							
Samples							
Rent							
Advertising Printing							
Advertising Space							
Advertising Mechanical							
Shipping Labor							
Packing Materials							
Expense Tools and Supplies							
Material Handling							
FIXED CHARGES							
Taxes							
Insurance							
Depreciation of Equip.							
Depreciation of Bldgs.							
Total							

Figure 39. Monthly Distribution Sheet of Sales Expense

since they are of the same character wherever found, it will not be necessary to discuss them again in this chapter.

**Salaries of Executives and Assistants.**—This account should be charged with the salaries of all executives in the sales, advertising, and shipping departments, as well as the salaries of the district managers and division or branch managers and assistants. It should remain constant except for the usual reasons, such as change in salary rates, etc. As is the case with all accounts covering salaries of executives, little is to be gained through analyzing the account, provided equitable standards of compensation have been established by the company's management. The amount of this account should, of course, bear some relation to the volume and cost of making sales, particularly in the various branches and divisions.

**Salaries of Salesmen.**—The direct salaries of salesmen are charged to this account. Straight salaries to salesmen take no account of individual effort and are sometimes an invitation to loaf on the job. At the same time it may be desirable to pay salaries to salesmen doing development work, juniors, new men, etc. The salary account must be analyzed in connection with the amount of sales, estimated sales, estimated and actual selling expenses, operating standards, bad debts, etc. As a rule, an incentive of some sort should form a large part of the salesman's compensation.

Such accounts as Clerical, Stenographic, Postage, Telephone and Cable, etc., will be discussed in the chapter on general administration.

**Printing and Stationery.**—This account has been discussed in previous chapters, but a word of caution is needed in connection with the use of this account by the sales department. Special material for salesmen, such as copies of letters of recommendation, copies of large orders, leaflets, advertising reprints, etc., should be charged to this account. Other heavy items of expense include the cost of price lists, pep letters, and the like. This account will, of course, vary from period to period and is not easily compared with previous periods. The

benefits derived from the expenditures for the items mentioned must determine the reasonableness of the expense.

**Traveling Expense.**—This account is charged with all transportation expense, railroad fares, automobiles, taxicabs, and similar items; likewise, hotel expenses, tips, meals, etc. Although the account varies from period to period, the total expenses of a period can be compared with another period provided salesmen are assigned to definite territories. The account should be analyzed to determine the legitimacy of each charge, the necessity for the expenditure, and the reasonableness of the amount. Lack of proper planning and scheduling of the movements of salesmen, failure to place restrictions upon expenditures, and the abuse of expense privileges are among the items responsible for excessive traveling expenses. The total of this account should be compared with the volume of sales for several periods and then a definite policy should be formulated covering traveling expenses.

**Entertainment.**—The cost of entertaining customers, prospective customers, and visiting members of the out-of-town sales organization is charged to this account. The account is used by traveling salesmen, branch managers, district managers, local salesmen, and sales executives. The cost of entertainment for a given cost period cannot be compared with the cost of a previous period, except as a matter of general information. The account varies widely from period to period and should be analyzed each cost period. An entertainment account for executive use only will need but little study, inasmuch as the executives are responsible for the economic operation of the business. Where the entertainment account is used by a large number of persons it must be watched carefully to prevent abuse and excessive use. There is only one way of definitely controlling this account, and that is to restrict its use and require from each individual receipts for each item of expense incurred.

**Insurance.**—This account includes the cost of all compensation, liability, health, accident, or other insurance which the company carries for its sales employees. The account is more

or less fixed, and inasmuch as it represents a managerial policy will require no further comment. Fire insurance is considered under the fixed charge account and automobile insurance is considered as part of automobile expenses.

**Adjustments.**—This account is charged with the cost of such adjustments and allowances are required in connection with customer relations. The salesmen should be notified of adjustments charged to the expenses of selling in their territories and should be required to furnish an explanation of the circumstances surrounding each adjustment.

**Demonstrations.**—To this account are charged the costs of material, labor, and all expenses incurred in connection with the demonstration of the product as a sales help. The results of demonstrations of the product cannot be measured and, therefore, the costs of making them cannot be easily justified. Waste or extravagance in the materials used for the demonstration often occur, and the account should be analyzed in connection with the particular demonstration to determine whether or not the costs are excessive.

**Exhibits.**—Charge this account with the cost of material, labor, and expense incurred in making up exhibits or exhibit boards for educational or advertising purposes. Certain window displays, permanent exhibits given to educational and technical institutions or societies are charged to this account. It sometimes amounts to a substantial sum and should be examined to see if improper charges are being made to the account. It should also be determined if the exhibits are being wisely placed and to the best sales advantage, and if the advertising department has been consulted and approves of the disposition of the exhibits. Exhibits are useful and many times are valuable advertising mediums for the company.

**Automobile Expenses.**—This account covers the cost of automobile operation by field salesmen. The items of depreciation, maintenance, tires, new parts, gas, oil, garage, license, insurance on car, bridge and ferry tolls, are charged

to this account. It is used only when the company furnishes automobiles to the traveling salesmen, or when salesmen supply their own automobiles and receive from the company a definite allowance for mileage covered. The total of this account from cost period to cost period will vary considerably because many of the expenses cannot be anticipated, and frequently heavy repairs are made and charged to the automobile expense account for a particular period. It is almost impossible to control this account effectively, but an analysis should be made each cost period to determine the items which are included in the account. Many attempts have been made to control the account, but none is entirely successful. The general methods utilized by management in an attempt to control this account are:

1. To make a definite allowance for the cost of operating the automobile per mile covered,
2. To allow the salesman a fixed amount per day, week, or month to cover automobile operation, and
3. To estimate the cost of operating and maintaining the automobile on the basis of the value of sales procured by the salesman, i.e., to determine a ratio of automobile operating costs to dollars of sales.

A plan should be formulated bearing in mind the topographical and physical features of the territory covered. The account is subject to abuse, and while an analysis will not definitely show the nature of the abuse, it will assist in establishing certain reasons or explanations for excessive automobile expenses. This may help the branch or division manager to concentrate his attention on the reduction of this expense.

**Commissions and Bonuses.**—To this account are charged the amounts of commissions and bonuses paid to salesmen on merchandise sold. Commissions may be paid as partial salary or as the entire salary of salesmen. Bonuses are usually given on a performance basis. The account will naturally fluctuate, depending upon the volume of sales. A ratio of salesmen's commissions and bonuses to gross sales, or to the cost of sales, may be established to assist in determining whether or not the

commissions paid are in proportion to the amount of sales, and other elements entering into the cost of selling. The analysis may show the desirability of changing the commission or bonus plan and substituting a different type of incentive plan, or changing the quotas or rates.

The amounts of commissions received by salesmen should be compared with sales returns, allowances, and discounts in their respective territories. If the analysis of salesmen's commissions is made by lines of product and classes of dealers, it may show that the salesmen are catering to the large dealers to the neglect of the small ones, or it may reveal that salesmen are concentrating on certain lines which yield high commissions, or are pushing the products which yield low unit commissions but in which there is little sales resistance to overcome. The analysis may show that the sales volume from a given territory is too low. This may lead to an examination of the volume of advertising done in the territory, or the activity of competitors.

Oftentimes a salesman lacks ambition to sell as much as the territory will consume. This not only costs the company money in lowered volume of sales, but allows competitors to make headway, and causes dissatisfaction among small dealers who may not be visited with sufficient frequency. It is, therefore, necessary to consider the territory and the individual salesman in connection with the analysis. Where uniform commissions are being paid on all products, the analysis may show that salesmen are concentrating on those products, requiring but little sales effort, although they yield the lowest margins of profit.

**Analysis of Bonus Account.**—In connection with the payment of incentive to salesmen the amounts are usually paid for reaching or exceeding sales quotas. The Bonus account, when analyzed, may indicate that the bonus plan is unsound and that quotas for salesmen are too high, too low, or instead of being set on total volume of sales should have been set upon the sales of each product or the cost of selling each product in a definite territory.



**Samples.**—This account is charged with the cost of the samples, labor, and expense of sample distribution. The Sample account may be active all the time or only at intervals. An analysis of this account will be helpful in determining the wisdom of the policy of sample distribution, comparison of cost of sample distribution in relation to territory covered and potential customers. If signatures are taken for all samples distributed, the cost may be compared to the value of the mailing list thus obtained. If coupons or postcards are enclosed with the samples, the returns should be checked with the cost of samples to establish a ratio between returns and cost per return. Much money can be spent in sample distribution without obtaining equivalent value therefrom.

This account should be carefully watched and the policy regulating sample distribution checked with the costs of measurable results obtained.

**Sales Conventions.**—Charge this account with all expenses incurred by salesmen or sales executives who are authorized to attend or conduct sales conventions. This account will include such items as traveling expenses, hotel accommodations, rent of convention rooms, professional entertainers, theatre tickets and amusement costs. It will be used infrequently and, therefore, no satisfactory basis for comparison will be found. Nevertheless, the account should be analyzed when it has been used.

The value of sales conventions and their cost are always matters of speculation. Many instances are known of sales conventions that resolve themselves into a gathering of the company's employees for the purpose of amusement rather than instruction, education, and help. The cost of conducting a convention may be excessive, in addition to sales lost while the men are not in the field. The discussion of the budget is usually an important matter for consideration at the convention, and unless the conduct of the convention is such as to keep the real business of the company before it, the value of a convention held for this primary purpose is likely to be nullified.

**Rent.**—This account is charged with the cost of rent of office space for the home office and the branch offices. The account is constant but should be examined at intervals to bring up the question of the desirability of the present location compared with other locations which might be secured on more favorable terms, or purchase of buildings.

**Shipping.**—There are certain accounts in the shipping department which are common to that division only. The account, Shipping Labor, includes the cost of labor employed in packing, boxing, and preparing merchandise for shipment. The account, Packing Materials, includes the cost of all materials used in packing merchandise, such as boxes, cartons, crates, and excelsior. An analysis of the Labor account can be made in the same manner as similar labor accounts previously mentioned.

**Analysis of Packing Costs.**—The cost of packing materials usually is a large item and requires attention. An analysis of this account should be made with a view to determining the value of the present method of packing, that is, the amount of breakage and damage to merchandise, the cost of packing in relation to the value of the merchandise, and also the effects of the present packing methods and materials upon transportation charges, freight classification, and express or postage rates. The analysis should suggest for consideration the cost of the containers used in packing when purchased from an outside vendor, as compared to the cost of making the packing containers within the plant.

The analysis of packing costs may be made according to lines of product or territories in which the finished product is distributed. Such an analysis may be helpful in determining the cost of packing and shipping according to methods of transportation, and to determine the difference in cost of packing and shipping according to methods of transportation, and to determine the difference in cost of packing for each class of transportation, or for each territory into which the product is shipped.

In one case it was discovered through such an analysis

that no profit was being made on one particular product, owing to the high cost of packing and preparing this merchandise for shipment. In this case, it had not been the practice to distribute the costs of packing according to the lines of product or territories, neither had the costs of packing been analyzed in conjunction with classes of products or territories served.

**Warehousing.**—The problem of working out a branch warehousing system is a tremendous undertaking for the manufacturer who decides to sell direct to retailers. This is particularly true if the product line is perishable or bulky, and if the extent of the whole market area to be reached is great. And yet the manufacturer cannot escape this problem when he sells direct. Retailers can secure quick deliveries from the jobber and from nearby manufacturers. They will demand the same service from distant direct-dealing manufacturers. To meet this situation the manufacturer will be obliged to construct warehouses, to rent space in public or private warehouses, to employ representatives to act as transfer agents, or to work out some combination of these methods. Whatever the program, it is certain to be costly. Of course, the extensivity of the necessary warehousing program varies with the type and quantity of product being marketed. High-grade specialty goods sold only to a few select outlets will not necessitate extensive warehousing provisions. Moreover, the relation between the intrinsic value of the product and its bulk will affect the problem.

**Analysis of Warehousing Costs.**—Warehousing is regarded in most cases as a part of the cost of selling, and if greater convenience or better classification is obtained by showing this account under shipping, there is no special objection to the practice. The cost of warehousing as well as cost of transportation from factory to warehouses should be carefully analyzed. The convenience of branch warehouses may be too costly. On the other hand, the ability to make drop shipments of small quantities, to make quick deliveries, and to secure better rail and terminal facilities may enter into the consideration of warehousing costs.

A separate classification of accounts should be established for warehousing activities, and these accounts should be compared and analyzed from period to period, so as to determine fluctuations in costs and to devise ways and means of reducing the operating expenses. The usual classification is as follows:

- Supervision
- Warehousing Labor
- Clerical Labor
- Office Supplies
- Printing and Stationery
- Postage
- Telephone
- Rent (if building or space is rented)
- Light, Heat, and Water
- Maintenance of Warehouse
- Maintenance of Equipment
- Maintenance of Industrial Truck
- Insurance
- Depreciation
- Taxes

In many cases, a second classification is necessary when packing, shipping, and transportation are included in warehousing costs, especially if large quantities of merchandise are shipped to the warehouse in bulk and repacked for shipment to customers:

- Packing Labor
- Packing Cases and Cartons
- Labels and Printed Instructions
- Transportation
- Truck Maintenance
- Demurrage Charges

In cases where the merchandise is reshipped from the warehouse without additional packing or boxing, then these expenses are handled in a similar manner as if they were incurred directly at the factory without the necessity for warehousing facilities.

The cost of operating a warehouse does not increase the value of the product and, therefore, must be considered expense.

**Advantage of Sales Ratios.**—Many additional accounts may be found in a particular sales expense classification, and much additional analytical work may be done to trace the variations and unearth the reasons therefore. The indefinite relationship existing between the cost of selling the product and the results of the expense, makes it essential that every phase of selling expense be watched constantly. The establishment of selling expense standards and ratios offers considerable help in the analysis and control of selling expense. It is usually possible, through the use of standards and ratios, to make a detailed analysis of any particular item of selling expense by salesmen, territories, products, terms of sale or delivery. The cost of making such a detailed study and keeping the necessary records occasionally is more than the value obtained from doing the work.

**Need of Control of the Expenses.**—Exact control of the expenses incurred in selling the product is essential if the enormous wastes now existing in the field of distribution are to be curtailed. Cost accounting for sales is a new development and one which promises to do much in this respect. The maximum results from cost accounting can be obtained only when the management realizes the necessity for carefully examining and analyzing each item of expense in relation to the conduct of the activity which causes that particular expense to be incurred. (The budget is the forerunner of expense control.) Standards, ratios, and constant expense analysis must follow if budgeting is to yield satisfactory results. These artificial devices are not the cure-all for high expenses and excessive costs; intelligent use of these instruments by an enlightened management can bring only that result.

## CHAPTER 26

### MARKETING POLICIES AND THEIR EFFECTS ON COSTS

**Importance of Marketing Cost Control.**—Effective consumer demand increases when selling prices are reduced and/or purchasing power is increased. There are three principal means of reducing selling prices. One is through greater economy in production, which would enable lower selling prices without impairing profit margins; the second is through reducing the unit margin of profit in order to increase total volume of sales, and the third is to reduce the cost of marketing the product in order to reduce selling price. Many of the preceding chapters have dealt with the possible ways of reducing production costs and this chapter will concern itself with ways of reducing marketing costs. It is often said that on the whole the costs of marketing our products are excessive. The reasons for the high costs are enumerated as including ineffective and wasteful advertising, lack of adequate knowledge of the markets, unwise marketing policies, inadequate marketing facilities, lack of proper training for those engaged in market activity and unnecessary activities and services presumed to be desirable. It is possible to prove in individual instances that marketing costs can be substantially reduced and reliable authorities have stated frequently that better cost control of market activities will promote efficiency. It is known that in the case of certain types of products, as much as 50% of the consumer's dollar is absorbed by marketing costs and profits to those engaged in the distributive function. More than one authority has estimated that at least one-third of the total cost to the consumer of a product is the cost of marketing and that a substantial reduction of this figure is possible. The only way in which these statements of opinion can be substantiated is

through an exhaustive study of actual marketing data and costs. Such studies are being conducted by various agencies such as the Department of Domestic Commerce of the U. S. and the American Marketing Association, and unquestionably factual data will be at hand soon to shed light on the question. Meanwhile it is necessary that all those engaged in the distribution of goods should devote much of their attention to exploring the possible sources of loss and waste in each of the marketing activities.

As a first step in this work leading toward good cost control of marketing, it is necessary to devise and install a system of cost accounts and records that will yield the information and data upon which sound management policies and practices should be based. The next step is to carefully train those executives and supervisors concerned with marketing work in the analysis, interpretation, and use of the records and data thus made available. The last step is to apply these policies and practices in order that those general and specific factors influencing costs and the control of marketing may be so regulated and used as to prove beneficial in this respect.

**General Factors Influencing Marketing Costs.**—Although there are but few instances in which specific cost elements of marketing will reflect these general factors, they are none the less important in their bearing upon costs and for that reason must receive the most careful constant study and check. Among the more important of these general factors will be included the following:

**Organization of the Marketing Activities.**—It is not intended to do more than stress the importance of good organization at this time since the subject was more completely covered in a preceding chapter. Nevertheless it is essential that the activities be so organized that, (1) they can be properly coordinated, (2) that good teamwork and cooperation can be developed and maintained, (3) that overlapping and duplication of effort can be avoided, (4) that responsibility can be definitely placed and authority delegated, and (5) that flexibility

and balance can be maintained. Unless these characteristics of organization are present, lost motion, waste, excessive costs, and many other undesirable forms of inefficiency will manifest themselves.

**Selection and Training of Personnel.**—Although the selection and training of personnel is an organization function, the subject is so very important in efficient marketing that to treat it separately may add needed emphasis. It is estimated that less than 1% of the retail grocers of this country have had suitable training either through experience or otherwise for their work. Perhaps the percentage of those who have been trained for their work would be substantially higher in the case of wholesale and manufacturing establishments. It is generally conceded that too little attention has been given to training. Wages, salaries, and commissions paid to salesmen and other personnel doing marketing work, account for a large part of the total cost of marketing and to the extent that poor selection or lack of training is present; to that extent each dollar of the wages and salaries paid will fail to yield the returns it should in terms of goods sold, services rendered, and profits made. At least half, if not more of the major elements of marketing costs are directly affected by the quality of the personnel and it would be difficult to find any element of cost not affected indirectly.

**Channels of Distribution.**—There have come into general use in our marketing economy, several specific channels through which goods may move from producer to consumer. The choice of one or more of these channels for the movement of particular goods will have an important bearing upon the total cost of getting the goods into the consumers' hands. The choice of a channel is made frequently without proper study to determine which channel should have been selected. As a result, increased effort and expense is involved in moving the goods through the channel selected because it is not the most efficient channel available in the particular case. Oftentimes the producer is so obsessed with the desire to increase his volume of distribution that he selects a channel because he believes through



its use he can accomplish the desired purpose. This he may do but oftentimes the increased volume is obtained at such a cost that the benefits do not offset the increase in costs. Similarly, by unwise choice of distributive channels, volume may be so restricted that the cost of distribution rises excessively. Frequently goods may be distributed through either of two channels with the same selling effort but the use of one rather than the other may cause increased financial charges, involve warehousing, extra handling, or some other problem which may in the last analysis make the total cost much higher. It does not follow that a channel in current use may continue to be the most desirable. Constant study and analysis of market data must be made in order to discern the need for changes in policies and practices.

**Pricing Policies.**—The price of any product must ultimately conform to the law of supply and demand. In the meantime, because this economic law works slowly, it is possible for a producer to so price his product as to bring disaster to his business. If he prices his product too low, volume of sales will likely increase greatly and losses due to selling below cost will be sustained. If the product is priced too high, volume of sales declines rapidly and sales resistance increases. This in turn is followed by increasing costs of manufacture and marketing and shrinkage of profit margins beyond the vanishing point. The producer must determine the desirable selling price of his product whether or not competitive and other conditions will permit its sale at this price. He must be aware of the possible effects not only upon marketing costs but also upon manufacturing and other elements of cost, of the price policy adopted. Arbitrary decision in the matter is dangerous, and may prove to be the cause of eventual ruin of the business. (It is axiomatic in manufacturing that as the volume of production increases the cost per unit decreases, assuming certain elements of expense to be constant and further assuming that the law of diminishing returns is not in operation. In a general way this cost axiom will hold true in the case of sales if it can be assumed that extra heavy expenditures are not being

made for opening markets in new territories and for other causes. Thus it is easy to see how a pricing policy that will net the largest number of sales and sales of the largest unit size will tend to decrease the costs of selling and at the same time will have beneficial effects upon total costs. When the price policy is such that sales resistance is increased, costs rise even though volume of sales does not decline. When the selling prices are lowered, costs of selling are presumed to decline but frequently sales resistance is encountered and selling expenses do not decline as rapidly as they should to reduce the marginal losses from below cost selling.

Although the producer has a somewhat definite price policy it will need adjustment during periods of rising and falling price levels. Failure to make these adjustments may cause substantial changes in marketing and other costs and in many instances may lead to destructive price competition. In New York State the Feld-Crawford Law permits a producer to maintain retail selling prices under prescribed conditions. This is designed to reduce competitive price wars and to aid in the stabilization of prices. In many ways this should benefit the producer although there are some definite drawbacks to the law as it affects him and all of the market agencies engaged in the distribution of his product. The Robinson-Patman Act, a Federal statute, tends to affect the costs of marketing through preventing price discrimination and placing the burden of proof on the producer for making price differences to purchasers. Both of these acts are so recent that full interpretations and test case results are not yet available.

**Advertising Policy.**—The use of advertising in one or more of its various forms has come to be such an accepted part of marketing practice that it is no longer a question of whether the company's policy will be to advertise or not, but rather a question of how much will be spent for advertising and what kinds of advertising will it do. The company's policy as to the nature and extent of its advertising will make a substantial difference in the cost of the advertising and thus a difference in the cost of marketing. There are a great many factors to be

considered in judging the efficiency of advertising and these will be discussed in detail in a chapter devoted to that subject. Here it is important only to emphasize the point that great care must be exercised in formulating the advertising policy for the company. The decision must be made as to whether such advertising as is to be done will be handled through a professional agency or whether it will be more economical to organize an advertising division within the company. There is no standard of practice in this matter. In the field of department store retailing it appears to be general practice to organize an advertising division of the company, while in many of the large industrial concerns, company advertising is handled through an agency.

The company must also decide as to whether or not advertising will be of a national, semi-local, or of a local character and through what established channels advertising will be done. The relationship to dealers and consumers in respect to advertising must also be determined. These are but a few points which will bear directly upon the success of the advertising program and which will directly affect marketing costs. Many details arising out of these and other policies that affect costs will be discussed in the chapter dealing with advertising costs.

**Discount Policy.**—The practice of giving price discounts based upon quantity purchases has been followed for many years in most types of business. The arguments for the practice have been that certain elements of marketing costs were reduced thereby and that the savings more than offset the amounts lost through discounts. While in theory this may be true, there is some doubt as to the practical outcome of quantity discounts inasmuch as cost accounting for marketing has been so inadequately developed. Carload versus less than carload shipments result in savings in handling, trucking, and freight charges. One order for a quantity normally covered by several orders reduces clerical costs of order filling and possibly also reduces the costs of order getting. If a salesman can reduce the frequency of calls on a customer by increasing unit quantity of sales, he has less traveling expense, and more time to use in

finding and serving other customers. In some instances and under certain conditions, a discount policy that encourages large quantity purchases may prove economical to the seller by enabling better organizing and planning of production. In various types of concerns and under differing conditions other advantages may be claimed for the practice. The point is that it must be known with certainty to what extent and in what ways quantity discounts are of value to the seller.

Cash discounts for prompt payment of bills is another form of discount policy that is currently used. On the theory that getting bills paid promptly reduces the possibility of loss from bad debts and the expense of making collections of delinquent accounts, the policy may be an economy. (The other reason for its adoption, that if bills are paid promptly there will be less need for borrowing working capital from banks, is open to question.) (The amount of discount granted may exceed the interest cost of borrowing the money from the bank. Of course, if borrowing is difficult because of the seller's credit standing at the bank or for other reasons, the granting of cash discounts for prompt payment may be an economy. However, it is well to make a careful analysis of the situation before adopting the policy.

**Guarantee Policy.**—The practice of giving a limited or unlimited guarantee on the product for a specified or an indefinite period of time may tend to reduce sales resistance and strengthen the sales presentation or the advertising of the product, but it sometimes acts as an invitation to customers to abuse products and claim adjustments or exchanges on the basis of the guarantee. Many unwarranted returns and adjustments as well as complaint correspondence arises from the guarantee policy. Often salesmen or service workers must expend time and money to handle complaints based upon the guarantee of the product before making the adjustment. There appears to be a growing tendency on the part of manufacturers to reduce or eliminate altogether any specified time within which the product is guaranteed. Through advertising and sales promotion, the companies doing this, endeavor to build

up customer confidence to the point where they will be assured of complete satisfaction if an adjustment is necessary.

There are perhaps other advantages and disadvantages of the guarantee which should be carefully analyzed before any policy is adopted.

**Service Policy.**—The sale of some types of products is made easier when the purchaser knows that the selling company is prepared to service the product during its period of use even though the service may be charged for. In other types of products requiring service, there are so many well-established privately owned service agencies that the customer is not concerned greatly over the fact that the producer does not provide service. Whether or not the seller agrees, as a part of the guarantee, to provide free or charge service for a limited or indefinite time should be decided only after careful consideration of the costs involved. Even where materials or repair parts are not furnished without charge, the cost of supplying free labor and of the clerical work incidental to handling service work may amount to a substantial sum. There are also various items of overhead expense that must be considered as a part of service cost.

**Policy Relating to Returns and Adjustments.**—It has been estimated by authorities in the retail marketing field that as much as 10% to 12% of gross sales are returned annually. In the field of manufactured products the percentage is estimated to be somewhat less but sufficiently high to be of considerable concern to the management since the quantity of returns very directly affects marketing costs. In the field of retailing, conservative estimates place the cost of returns at an average of 50 to 60 cents per item and in many cases the average for a store would be substantially higher. In the case of manufacturing plants, the estimated cost of returns, including return transportation, exceeds the estimated cost on retail establishments by varying percentages depending upon the types of products handled. Sufficient evidence is at hand to show that in all kinds of marketing, the cost of returns is

high and that much of the cost can be eliminated through preventing returns. This does not mean that company policies should prevent the return of merchandise where there is justifiable reason therefor. It does mean that all precautions should be taken to see that the proper quantity and kind of merchandise is placed in the hands of the customer the first time and thus avoid returns and exchanges. Returns due to customer mistakes and dissatisfaction cannot be avoided except as the seller is able to aid the customer to avoid mistakes and to sell only merchandise that is in proper condition for sale.

Among the causes of heavy returns may be mentioned wrong size markings, substitution of merchandise, breakage or damage occurring during shipping, misrepresentation, high pressure selling of goods which customers should not purchase, overselling and overstocking; or failure to make only authorized statements about the product, promoting customer return privileges which the company does not officially sanction, defective merchandise, misunderstandings as to price, use, service, or other conditions or considerations; slow moving stock, new models, designs or products coming on the market, and tardy delivery. It is not difficult for management to find ways of eliminating many of these causes and of reducing the frequency of returns from those which cannot be eliminated provided the importance of this subject is recognized and its influence upon marketing and other costs is known.

The problem of handling adjustments is a part of the problem of dealing with sales returns. It arises out of the same general set of circumstances, affects costs in essentially the same ways, and requires the study and control of the same general causes in order to bring about reduction in the cost of adjustments.

**Policy Covering Areas of Distribution.**—In order to get a satisfactory volume of sales, many producers undertake to distribute their products in a national or a semi-national market. Unless a thorough study of potential consumption is made before such a policy is adopted it is highly probable that such coverage will be uneconomical. Frequently, a larger volume

of sales aids in smoothing out manufacturing schedules and promotes greater efficiency in production. However, these benefits may be more than offset by increases in the dollar cost of sales if distribution is attempted in areas where potential volume of business is too low, or costs of order getting too high in relation to volume. Field salesmen should not be sent into areas that do not yield satisfactory volume. Customers in such areas should be served by mail or not served at all. If the analysis reveals a potential volume that would net a profit, then of course, the area is open to development unless such an increase would result in overloading productive facilities or causing premature and unwarranted plant expansion. Wholesalers and large retail department stores frequently attempt to cover areas which bring additional volume but which do not yield a sufficient margin to warrant their coverage. The traveling expenses, the salesman's time, and the cost of delivering the merchandise are among the more important items of marketing costs that are affected. It is important to realize, however, that frequently the salesman thus spending his time does not have the necessary time to render adequate service to his paying customers, nor does he have necessary time to develop new customers of profit-making importance.

**Minimum Order Policy.**—Just as there are territories in which a company cannot afford to sell, so also are there customers to whom the company cannot afford to sell. The theory that it pays to take care of the small purchaser even at a loss because he will give you his business when it grows to a paying size is not tenable. Business should not be based on a matter of friendship and instead of giving you his business he might regard you as a poor business concern to deal with because you were willing to take and possibly solicit business on which you lose money. Moreover, there is little reason to believe that the small business will ever grow up. If it should, the time may be so far distant and conditions so changed, that you will not logically inherit the orders. Many examples could be cited to show unprofitable business being handled from buyers whose annual volume was as unprofitable as each individual

order. A periodic analysis of the accounts receivable will aid in discovering those customers who do not buy in sufficient volume over a period to warrant handling their account. Again, it will indicate the need for education of buyers to larger quantity buying so that each purchase may show its own gross profit. While this is not always possible it should be the ideal for which to strive. Accurate knowledge of the cost of order getting and order filling should enable the seller to adopt a minimum order policy that would tend to eliminate those customers whose business is unprofitable and at the same time would serve as a partial guide to salesmen in their search for new customers.

**Policy Covering Product Line.**—The practice of carrying a complete line of products as to size, shape, dimension, color, or other characteristics is seldom a profitable one. Many sellers believe that such a practice is necessary in order to satisfy customers but experience of other sellers has demonstrated conclusively that this is not necessarily so. In many cases, products are carried in the line and oftentimes are sold at a loss. Lack of cost accounting for marketing makes it difficult to discover this condition, and the belief that customers demand that the seller carry a complete line operates to prevent change even though the fact is known. In a great many cases of public record the facts are clear that usually from 10% to 25% of the total variety of products in the line account for from 60% to 90% of the total volume of sales and in many cases a single variety accounts for no more than one-half of 1% of gross sales. The cost of preparing samples, catalog descriptions and illustrations, price lists and other clerical costs connected with order getting and order filling are among the marketing cost elements affected, but this does not tell the story. Production costs are increased when it becomes necessary to put through many small orders. The record work, inventories, and breaks in production schedules make production more difficult and tend to cause costs to increase rapidly. In most cases it is possible for a producer to conduct educational work among consumers with a view toward making them aware of the



situation and winning their cooperation in continued buying of the profitable lines and obtaining their requirements of the discontinued articles from other sources. The idea is usually not difficult to sell, for the purchaser can see benefits to himself in cooperating with the producer. The Bureau of Simplified Practice of the Department of Commerce of the Federal government has published much material showing the benefits of simplifying the product line. The effects of the practice on production costs, inventories, stock turnover, and marketing costs often amount to as much as 10% to 30% increase in net profits, even though in some instances, total sales volume drops 10% to 20%.

The point must not be overlooked that wholesale and retail dealers have the same problem concerning the lines of product they should stock. It is altogether likely that they can reduce their marketing costs through proper analysis of sales and profits by lines of product. In a similar way, banks, hotels and other personal service types of business must examine the cost versus the profits made from various types of services rendered with a view to eliminating those that prove unprofitable in themselves or which do not directly and measurably aid in increasing sales and profits in other lines. The idea of carrying complete lines and loss leaders or special services to attract customers may be sound, but the soundness and value of the idea cannot be presumed to exist, it must be proven in terms of costs and profits.

**Sales Promotion Policy.**—The extent to which a seller attempts to stimulate sales, reduce sales resistance, and develop new customers through such sales promotion methods as sample distribution, window demonstrations, exhibits, and various other ways will be reflected in his marketing costs. It does not follow that such activities will unfavorably influence costs, for if they are effective other elements of order getting costs will be reduced and volume will be increased. The point is that these and all other sales promotion activities must be carefully planned and timed to conform to direct selling and advertising activities, if best results are to be obtained.

**Warehousing Policy.**—A company which distributes its products in a national or a semi-national market may find it an economy to operate one or more warehouses at strategic points in the sales areas. Such a practice may permit carload shipments from factory to warehouse and subsequent less than carload distribution to purchasers by motor truck or railroad freight at substantially lower costs. Such a policy also aids in speeding up delivery service to customers and is often a very important factor in rendering service in connection with repair and replacement parts.

The location of the warehouse in relation to receiving and shipping facilities, the internal arrangement of the space, the choice of facilities for housing materials to be kept in the warehouse, the selection and installation of materials handling equipment, the nature and quality of the record system to be used for inventory control, receiving and shipping, the adequacy of training for clerical and merchandise handling personnel, and the efficiency of supervision are among the factors that directly influence the cost of warehousing operations.

The problem of balancing warehouse stocks in relation to sales needs and manufacturing conditions not only affects the cost of operating the warehouse, but also affects directly the cost of manufacturing and the cost of financing. In many instances, the requirements of the territory to be served from the warehouse have not been sufficiently well studied to determine the classes and quantities of stocks that should be carried in the warehouse. As a result, overstocking of various items, shortages in others, obsolescence, damage, and other wasteful conditions arise at the warehouse. These conditions frequently react upon manufacturing schedules to cause rush orders, interruptions to production of one line to fill warehouse shortages in other lines, speeding up of production for the undesirable purpose of accumulating overstocks in warehouses and tying up working capital unnecessarily and oftentimes straining bank credit too much or increasing the cost of borrowings. The policy of branch warehouse operation should not be accepted as sound until the necessary investigation has been made to determine if an economy can be gained by the practice. Then

careful study should be given to the question of the use of public warehouses rather than renting space or constructing warehouse buildings. There are many warehousing companies throughout the country properly equipped to house and handle all classes of merchandise and it is frequently more economical to make use of these existing agencies than to develop a company owned and operated warehousing system.

**Salesmen Compensation Policy.**—The choice of a plan to be used in compensating salesmen may have an important bearing upon the total costs of marketing as well as upon the successful distribution of the company's products. Unless the compensation plan takes into account the various phases of sales effort which the company expects of the salesman, these efforts are not likely to be made by him. Difficult lines of product may not be pushed; or to say it another way, products meeting little sales resistance but which yield low profit margins may account for the larger percentage of a salesman's total sales, new customers will not be obtained, complaints ignored, and in general, customer welfare may not receive the attention it should. The company has the responsibility for deciding what it wants from the salesman and developing a wage payment plan that will stimulate him to produce these results. Here it is desired only to emphasize the great importance of carefully selecting a plan that will be equitable to all parties and one which will include provisions for each type of result or activity that the company desires from the salesman.

**Policy of Dealer Relations.**—Many competitive practices have grown up in the marketing field within recent years that tend to emphasize the growing importance of dealer relationships. In addition to these practices, recent Federal and State legislation has complicated these relationships and at the same time stressed their importance. While most aspects of the problem are usually handled as a part of sales promotion it is desired here to point out that company policy in regard to this subject will tend to influence marketing costs in many ways and indirectly will influence all business costs. Money spent

for advertising and sales promotion cannot be fully effective without good cooperation from dealers. Similarly policies covering guarantees and adjustments cannot be made fully effective unless the dealer is willing to take whatever time and trouble is required to keep customers satisfied as the company wishes them to be. In connection with price maintenance, returns, customer complaints, private brands, unusual service to customers, and many other similar matters, the company's policy as it relates to the dealer will determine the extent of cooperation, the interest of the dealer in furthering the company's interests, and his attitude toward the company which he, in turn, communicates to his salesmen and his customers.

## CHAPTER 27

### CONTROL OF ADVERTISING COSTS

It is absolutely impossible to determine the amount of money spent yearly in the United States for advertising but the New York banks have roughly estimated that the figure is well over two billion dollars. Assume that the figure is correct. No one knows how much of that money is wasted and it is safe to prophesy that no one ever will know. However, most of our larger concerns are making efforts to analyze their costs of advertising and to measure these costs against the results from advertising. The majority of cost accountants abhor the thought of collecting, diffusing, and analyzing advertising costs because they are the most difficult of all costs to analyze in terms of measuring the effectiveness of the money spent. There is little written on how to determine and control advertising costs and for this reason the accountant is more or less at a loss to know how to interpret the costs in terms of managerial requirements.

**Value of Advertising.**—There are definite principles governing the science of advertising, but even experts disagree in their practical interpretation. An expert examining two advertisements for similar types of cosmetics stated that advertisement "A" was much better than "B" because in "A" there was plenty of white space around the advertisement which permitted the reader to rest his eyes; but the results from advertisement "A" amounted to 6,793 inquirers, where as "B" brought in some 11,016 replies. In another case two tourist agencies advertised in a well-known magazine; "A" was judged to be the better advertisement because the type was larger and would be more easily read than that of "B," however, the results showed that "A" brought only 437 inquiries while "B" brought 2,310.

In both of these cases it was impossible to predict the value of the advertising, and only when the returns were analyzed could the costs be determined in terms of value. However, most advertising is of such a nature that the returns from it cannot be directly measured within any given length of time, and therefore, the analysis of its costs in terms of value is not possible.

**Purposes of Advertising.**—Advertising creates a demand for a product, it acts as an introduction for a sales representative when interviewing a prospective customer. It reduces the time and effort of the selling force in convincing the buyer of the merits of the article and it aids in obtaining wider distribution of the product. Professor W. B. Cornell<sup>1</sup> summarizes the purposes as follows:

1. To get immediate orders.
2. To introduce a new product to the general public and give it prestige.
3. To educate the public in the use of the product.
4. To create good-will.
5. To overcome prejudice.
6. To keep up the demand for standard products by keeping the product before the eyes of the public.
7. To meet competition.

**Status of Advertising Activity.**—Much argument prevails among industrial and marketing executives as to the proper status of the advertising department. Some contend that advertising is a major activity and as such should be separately constituted with an executive head reporting directly to the general manager. Others contend that advertising is logically a part of sales and should, therefore, be a division of the sales activity, functioning under the executive control of the general sales manager. It frequently happens in some types of manufacturing or commercial concerns that the advertising work is performed largely by an advertising agency. In such cases a junior executive and a clerk in conjunction with the agency

<sup>1</sup> W. B. Cornell, *Organization and Management in Industry and Business*, The Ronald Press Co., 1936, p. 441.

take care of the work connected with advertising. As a general rule it is more costly for a company to do its own advertising than to have it handled by an agency, but the difference in cost may be more than off-set by the results obtained through the company's efforts and efficiency. However, where a company is handling its own advertising, its accounting system should include a detailed classification of accounts covering the advertising expenses, which would make it possible to compare its costs of advertising with the charges that an agency would make for the same work. Seldom can advertising be successful unless there is harmonious cooperation between the sales function and the advertising function. Thus, a company organized to conduct its own advertising must so relate these two functions that close coordination can be established and maintained.

**Organizing for the Advertising Campaign.**—The general sales manager and the advertising manager must definitely decide the objective of the advertising campaign, the methods to be utilized, and the cost of obtaining that particular objective. The task of advertising in the campaign may embody the general purpose of the whole marketing campaign or may attempt to carry out a portion of the general objective. It may assist in the accomplishment of the general aim by directing its efforts toward a supplementary objective. In any case, a specific objective for advertising should be chosen. Some of the possible specific purposes are as follows: (1) to introduce a new use for an old product, (2) to introduce a new brand of an old commodity against existing competition, (3) to increase the sale of an established product at a predetermined rate against existing competition, (4) to maintain the present volumes by a "reminder" campaign, (5) to make a trade mark or brand name more generally known, (6) to change or modify an established buying habit, and (7) to overcome a market indifference or prejudice.

**Timing the Advertising Campaign.**—Coordinating the advertising campaign with the sales program is a fundamental

of good management. However, this is easier said than done. Changing economic conditions, changes in products, new legislation, changes in competitive practices, and many other conditions may arise to upset the sales program. When these conditions exist an immediate adjustment of the advertising campaign is necessary, because space may have been contracted for, illustrations and copy prepared (art possibly submitted to the medium, or all cast and ready for use), and perhaps other plans have been made. It may be very difficult to make the adjustment quickly enough so that the advertising department may give the sales department the maximum of assistance. Frequently, the opening of new sales territories, the introduction of a new product, or other sales plans must be temporarily delayed while the advertising to accompany the sales plan must go on even though much of its effects will be dissipated before the sales department can make use of them. These are but a few of the problems that arise in the effort to synchronize advertising and sales, but they illustrate very clearly some of the difficulties, as well as the importance of giving special attention to the subject. There are a few more certain ways of getting low dollar returns on money spent for advertising. Pennies spent for advertising should chase dollars of sales, but unless sales and advertising are properly timed, the result will be spending dollars for advertising to chase pennies of sales. One can readily realize how these conditions will increase the cost to sell the products or services of any concern.

**The Advertising Appropriation.**—An appropriation for advertising expense should be set only after a critical study has been made of the requirements; the expenditure from this appropriation should be classified and utilized in accordance with the plans established and approved by the advertising executive. In utilizing the appropriation, a proper balance of expenditures between the various lines of product must be maintained. Many methods have been set forth for determining the advertising appropriation. From a study of these methods perhaps the most convenient and most widely used is the percentage method, which consists of setting aside a definite



percentage of the previous year's net sales to cover the cost of advertising.

This method relates advertising expenses to sales income. It is easy to compute and definite in amount. Successful and efficient advertising should increase sales and thus increase the appropriation for advertising. The other methods are:

1. Setting aside a determined percentage of the previous year's gross sales.
2. Setting aside a determined percentage of the anticipated gross or net sales.
3. Setting aside a determined percentage of the previous year's net profit.
4. A determined sum of money appropriated to "out-do a competitor." Such an appropriation should be made out of current earnings if possible.
5. A definite sum of money appropriated to "Finance in Objective."
6. Appropriate a fixed sum for each unit of product.

The last-named methods are obviously the most sound. It amounts to a decision on an objective and then the figuring up of the cost of the advertising required to attain the objective. When the resulting total is more than the advertiser can wisely appropriate, the best procedure is to reduce the appropriation by changing the objectives.

When the appropriation is set by an arbitrary percentage method, it is necessary to analyze the total fund and distribute it over the whole line. The apportionment of advertising moneys among many different products can be guided to some extent by adhering to the following marketing principles: (1) a new product requires more advertising than an established product, (2) a product that is in a highly competitive field may need a considerable amount of advertising, and a product in which style or perishability is a factor ordinarily needs more advertising than a staple product in which these two elements are unimportant. In general, however, the advertising appropriation should not be broken down analytically. It should be set up synthetically, by proceeding to the total from an individual's consideration of one product after another.

**Effect of Successful Advertising.**—An efficient and successful advertising program should accomplish very definite results in the way of economies. However, it must be remembered that the particular company must be one in which increased production will result in decreased unit costs.

1. The volume of sales should increase as a result of advertising. If the volume of sales increases, it will ultimately require increased production, which in turn may result in lower costs per unit of product thus increasing the profits to the advertiser.
2. Selling expense should decrease. Advertising reduces selling costs by reducing the sales resistance and thus saving time and expense of salesmen. The costs of personal selling decrease by a greater amount than the costs of advertising.
3. Selling price of the product should be decreased. The product may be offered to the consumer at a lower price, when the decrease in cost of production is greater than the cost of advertising.

**Accounting Treatment of Advertising Expense.**—The general method for handling advertising costs is to charge them to the advertising expense account which usually appears as a separate item under the caption of selling expenses on the profit and loss statement (see page 544). In many concerns, advertising costs are charged directly to the sales expense account and there buried for all time. The proper method for handling costs of this nature is to set up the usual controlling account for Advertising Expense in the general ledger and carry the itemized accounts under an appropriate classification in a subsidiary ledger.

**Classification of Advertising Costs.**—Like every other phase of business activity, the advertising department should be given a detailed classification of accounts, so that the cost accountant may be in a position to record readily and analyze the expenses and thus check them with the appropriation established. If a classification is not set up it is very possible that many important items of cost will be buried in the advertising

expense account, and such an account may become a dumping ground for certain items which management is not supposed to observe.

Each of the individual accounts in the classification may be further broken down into component expenditures and is classified according to the item, if the cost accountant so desires. For example, the "Catalog" account may be subdivided into the following classification of accounts:

- (a) Salaries
- (b) Photographs
- (c) Art Work
- (d) Printing
- (e) Paper
- (f) Editorial
- (g) Office Supplies
- (h) Mailing
- (i) Telephone

The advertising classification consists of four major groups of costs with appropriate accounts for each item of expense.

#### 1. ADVERTISING PRODUCTION:

Name	Material		Labor		Total	
Photographs						
Drawings						
Art Work						
Typography						
Etchings						
Engravings						
Mats						
Proofs						
Electrotypes						
Printing						
Supplies						
Research						
Supervision						
Fixed charges						
TOTAL						

## 2. ADVERTISING MEDIA:

Class	Cost
Newspapers General magazines Business publications Trade papers Farm publications Industrial publications Religious publications Class publications Directories Catalogs Theater programs House organs Direct-mail Booklets Folders Outdoor advertising Radio broadcasting Street and railroad cards Store and window displays Dealers helps Calendars Novelties Signs Motion pictures Cooperative advertising with trade Advertising on trucks Postal meters	
TOTAL	

## 3. SALES PROMOTION:

Classification	Material	Labor	Total Cost
Sales manuals Samples Contests Premiums Motion pictures			
TOTAL			

## 4. ADVERTISING ADMINISTRATION :

Classification	Cost
Supervision Clerical Stenographic Office supplies Postage Express Printing and stationery Telephone and telegraph Traveling expense Insurance (life and group) Light, heat, and water Maintenance of buildings Maintenance of equipment Education and training Advertising association dues Fees paid to advertising agencies Commissions paid Research Service fees paid to consultants Rent Taxes Insurance (fire) Depreciation of buildings Depreciation of equipment	
TOTAL	

Theoretically, any expenditures which aid in attracting attention to a commodity or making a sale is chargeable to sales, advertising, or sales promotion costs. Many times it is difficult to allocate such charges and therefore it requires wide discretion of the accountant or sales manager. For example, attractive cartons, labels, etc., do have a certain advertising value but as a rule the costs of these are generally considered sales expense.

**Circumstances Alter Charges.**—Certain expenses may either be charged to sales or advertising depending upon the circumstances surrounding the particular case. When the

house publication or house organ is sent to customers it is usually considered a part of advertising expense but where the same publication is sent to dealers, the cost is charged to sales expense. If the publication is distributed to the employees of the plant, then the cost is charged to factory administrative expense.

The cost of samples sent directly to dealers is considered sales expense while the cost of those samples sent to customers or distributed to the public is usually charged to sales promotion.

**1. Advertising Production.**—The first major classification of advertising costs deals with the physical production of advertising which represents to a considerable extent the work of specialists and therefore is most costly. It consists of taking and preparing photographs, doing the necessary art work, typographical designing, engraving, and all other work in connection with the actual mechanical and productive phases of advertising.

A job order should be issued for each individual job and the costs involved in doing the work should be accumulated in accordance with the classification set forth on page 491 under the respective headings of material and labor. In this way it is a more or less simple matter to procure the cost of each job.

The expenditures for the type of advertising work should be carefully and thoroughly analyzed so that waste and inefficiency may be revealed. The costs of each specific job should be compared with a standard or with those of a similar job so as to determine whether or not the costs of doing the work have increased or decreased above or below the set standard. In either case an analysis should be undertaken to determine why the variation exists, which may be due to one or more of the following causes:

#### INCREASES IN COSTS

<i>Material</i>	<i>Labor</i>
1. Market increase in the price of material	1. Increase in wages or salaries
2. Excess spoilage	2. Excess spoilage
	3. Incorrect recording of time

3. Incorrect recording of requisitions on cost sheets
4. Theft of materials
5. Changes in equipment, processes, or methods
6. Too exact inspection of work
7. Incorrect or incomplete specifications
8. Failure to issue credit slips for material not utilized in production
9. Inefficient control of production
10. Inefficient purchasing of requirements
11. Inferior materials used
12. Inefficient supervision
13. Inefficient cost system
14. Personal work for employees charged to production
15. Inefficient or inadequate storage facilities for materials
16. Inefficient inspection of materials
4. Incorrect distribution and recording of time tickets
5. Changes in equipment, processes, or methods
6. Idle time
7. Inefficient time studies
8. Poor supervision
9. Defective machines, tools, or materials
10. Excess supply of labor
11. Class and type of workers
12. High labor turnover
13. Poor wage payment plan
14. Inefficient cost system
15. Labor difficulties; strikes, walkouts; or sit downs
16. Dishonesty of workers or supervisors
17. Undesirable working conditions
18. Mixed sexes
19. Overtime
20. Too long working hours
21. Change from machine to hand labor or vice versa
22. Personal work for employees charged to production

The factors which may cause a reduction in these costs are essentially the reverse of some of the causes for increases, such as decreases in the market price of materials and labor. Decreases in costs should not be accepted as due to increased operating effectiveness without a very careful examination and study of the reason for the decrease. It happens many times that instead of economy in operation being responsible for decreased costs, it may be the result of maladjustments which will result in serious complications if not discovered before the damage is done. Therefore, it is always desirable to examine decreases in costs as well as cost increases.

In a concern which is engaged exclusively in advertising work the costs of production and expenses incurred are handled in a similar manner to that of a regular manufacturing concern and the analysis of costs are performed in exactly the same way.

**2. Advertising Media.**—A definition for an advertising medium is—any vehicle used for conveying the advertiser's appeal to the public, such as those stated in the classification on page 492.

The selection of advertising media also presents a complicated and difficult undertaking. In the broad sense, the task is two-fold. Classes of media must be selected and individual media within the classes must be singled out for use.

The cost and effectiveness of the advertising program is so greatly influenced by the selection of the medium that great care and thoroughness must be exercised in making the choice. Not all media are of equal value for an advertiser's purpose, nor are they all of equal value for particular types of advertising.

A more usable classification of media is based upon the type of audience reached by relative forms of media. On this basis, media may be classified as (1) mass media, (2) publication media, and (3) direct-mail media. Each group has its particular advantages. Mass media, like billboards, painted bulletins, car cards, window signs, etc., offer their messages to one and all. They are not selective but they are widely inclusive. Publication media are far more selective. The magazine appeals to readers that possess a common interest. It is not selective in the geographical sense but in the sense of the reader's nature and acquired interests. The newspaper retains some of this same type of appeal but is also selective in the geographic sense. Direct-mail media ranging in form from a mailing card to a thousand-page catalog offers its users an absolute control over the possible readers to which it is sent.

In any process of selection, three rather definite steps of procedure should be followed. Media should be evaluated in terms of the market they reach; selections must be made in the type of market for the product line in mind. Then comes the question of cost. Media should be evaluated in terms of the cost of reaching each possible buyer. Finally, the prestige of a proposed medium should be considered carefully as that prestige is reflected by the number and kind of readers, the amount paid for the publication, the editorial content, the



fiction and non-fiction content, the type of advertising, and the like.

These matters can be ascertained by consulting rate and data services, reports of the Audit Bureau of Circulation, and by a study of the medium itself.

A critical analysis of the various types of media should be undertaken to determine the value of each in terms of reaching those prospective customers to whom the appeal is made.

In case of newspapers, magazines, and books, such an analysis should reveal the nature of the media, its circulation, the class of public reached by it, the editorial content of the medium, and the services from which the news is derived.

In the case of magazines and other publications the place and position of the advertisement along with its size will have a very definite bearing on cost. This fact must also be considered in making the analysis.

Radio broadcasting is probably one of the most successful types of media used for advertising. It is estimated that the radio broadcast may reach some 65,000,000 persons. However, it is costly for the advertiser, but undoubtedly it pays for itself in the long run.

Direct-mail advertising applies to more or less specialized types of products, the results of which may be measured and its cost kept consistent with its productivity.

An analysis of direct-mail advertising should be made in terms of inquiries received and sales accomplished. The cost of such advertising may be obtained by dividing the total expenses involved by the actual orders received, which will give the cost of advertising per sale.

Many of the large business concerns have produced sound and silent motion pictures showing how their products are made and their uses. These films have a wide distribution to educational institutions, clubs of all kinds, selected technical and non-technical groups, conventions, and individual prospective customers. Business men in general do not realize the advertising value of such films to potential users of their products. This method of advertising is probably one of the most effective.

The cost of providing a film is somewhat high but usually it is believed that the expenditure is a good investment in advertising. The cost of the films may be capitalized and a portion written off to the cost of advertising each time the film is projected.

In analyzing the costs of the various forms of media, the point to be remembered is, that the inestimable value of the good-will spread by the advertising cannot be measured in dollars and cents. Thus, the analysis of the various accounts should take the form of discovery of waste in advertising, the space occupied and position of the advertisement, the medium used, and the results obtained by the advertisement.

The classification of accounts suggested on page 492 serves as an excellent basis for making an analysis of the expenditures involved in advertising media. If it is so desired, each account may be further subdivided to show the details of that account and where possible it is always desirable from a management viewpoint to measure the results against the expenditures so incurred.

**Catalogs.**—The cost of catalogs can be distributed on the basis of the space allotted to a particular product. It is a comparatively simple matter to determine the cost of each catalog page and further reduce it to cost per square inch of space.

**Space.**—Closely allied to the task of selecting media is the problem of deciding upon amounts of space to be used, position of the advertising, frequency of insertion, and time of insertion. For example, advertising in a morning newspaper, on picked days of the week may be exceedingly profitable to certain types of advertisers. A certain position in a definite section of a Sunday edition may be all that some advertisers can profitably use so far as newspapers are concerned. All these matters deserve the most careful study, as the size and frequency of the insertion will directly affect its cost and value.

Economy in space does not mean purchasing the minimum amount of space that will permit the insertion of the desired

copy, nor does it mean a crowded, uninteresting-looking advertisement. It does mean that each advertiser should determine as accurately as possible the most desirable amount of space for each insertion.

**Insertions.**—Out of sight out of mind is accepted as true by most advertisers and oftentimes, as a result, it is necessary to cut the cost of each insertion in order to run the advertisement a greater number of times, consistent with the appropriation. If the size of the insertion is reduced to save cost, it may very well reduce the effectiveness of the advertisement to a point where its value is not proportionate to its cost. Again, a single insertion or its equivalent in radio broadcasting, outdoor, or direct-mail advertising may be largely a waste of money. Generalizations in this field are dangerous and every effort must be made to predicate the advertising program upon the soundest possible basis. The number and frequency of insertions necessary to introduce a new line of products, or to announce a new use for existing products, or to keep the product before the public, or to accomplish any other of the results striven for through advertising, is a difficult problem to solve, but if solved the correct answer will mean that no more money will be spent for insertions than is needed to produce the desired results.

**Copy.**—Writers of advertising copy frequently lack familiarity with the product, its uses, the selling concern, and that company's policies, the people buying the product and their psychology, and thus, the copy may not carry the appeal or interest those who observe it. The obvious difficulty of trying out copy, lack of yardsticks by which the value of copy may be measured, increases the difficulty of developing standards in this field. Efforts to give copy a universal appeal frequently reduce its appeal to all. Expertness in copy-writing is not altogether a product of training or experience, it involves many considerations and because of this, good copy is all the more difficult to produce; therefore, it is easy to see that if the copy does not fulfill its purpose, the money spent for the advertisement will not produce satisfactory returns.

**Layout.**—The arrangement of the copy, the illustrations, the type faces, and the colors of ink are among the factors to be considered in the layout. It is a physical, an artistic, and a psychological problem, and like the layout of an office or factory, the layout of an advertisement must effectively utilize space, it must be appealing to the eye, and at the same time give such prominence to the appeal as will make it most effective. An illustration that detracts from the copy, colors that are displeasing, copy that is too difficult to read, disproportionate allowances of space for copy and illustration, poor selection of type faces, poor choice of illustration, imperfect mechanical work in the preparation of the illustration, are among the causes of bad layout and thus increases the costs of advertising by reducing its effectiveness.

**3. Sales Promotion.**—It has been defined as the link between sales and advertising. It consists of personal contacts between the sales representative and the customer or prospective customer; it embodies those aids which tend to promote a sale and which are of material help to the sales representative.

In organization the sales promotion activity is a comparatively new function and is, at the present time, considered a most important phase of advertising.

#### **Objects of Sales Promotion.—**

1. To correlate the effort and the work of the sales function with that of the advertising activity.
2. To aid the salesman in obtaining a sale.
3. To discover and develop new materials, through research, for making sales.
4. To induce customers and prospective customers to purchase definite types of products.
5. To develop and devise new sales opportunities.

Sales promotion includes the following important aids: sales manuals, samples, contests, premiums, and portable motion-picture projectors, and films. Inasmuch as sales promotion is a personal matter it is comparatively easy to distribute the costs of sales promotion to the sale directly.

**4. Advertising Administrative Costs.**—The administrative function of advertising deals with the formulation of the advertising policies, planning the work, coordinating advertising with sales, and controlling and directing all phases of activity within the scope of advertising. Because of the very nature of functions, it requires the service of highly skilled executives and technicians who are thoroughly versed in the application of the principles of management and advertising. Therefore, as a general rule, the costs of operating the function probably will be high but warranted.

To facilitate the collection, assembly, and distribution of advertising administrative costs, a suggested account classification will be found on page 493, showing the individual accounts to which the various expenditures should be charged during each cost period. A more detailed classification may be used by those concerns which deem it necessary from the standpoint of greater cost control and finer analysis.

Like all forms of administrative costs advertising administration is difficult to measure in terms of specific units and, therefore, the expenditures involved must be interpreted in terms of value to the concern as a whole. Costs will be more or less constant from period to period.

The majority of the accounts in this classification have been explained in the chapter dealing with general administrative expense, and their analysis should be conducted along similar lines.

**Diffusion of Advertising Costs.**—Many concerns starting in business charge all the advertising expense during the commencing period to the Good-Will account. The theory behind such accounting procedure is based on the fact that large advertising expenditures are both necessary and desirable to place the product and the name of the company before the public, thus creating good-will; and that such expenditures should not be charged against the immediate profits. However, it is believed that the better practice is to charge this advertising expense to an account known as "Prepaid Advertising" and write it off to advertising expense over the preceding period of

years. The amount written off each month should be charged to the cost to sell the various products on a predetermined equitable basis, depending of course on the type of product and volume of sales.

Where possible it is always desirable to charge the cost of advertising directly to the product, but this is not always feasible. Again good judgment must be used by the person doing the distribution. Advertising either deals with definite products or is institutional in nature.

Where one product is being advertised that product consumes the advertising expense, with the exception of that part of the advertising which places the name of the company before the public and aids the concern as a whole.

The problem involved is the determination of the amount which should be charged to each product and territory in which that product is advertised, and that is based on the cost of advertising in each territory.

Where the advertising covers a number of products, then the cost of advertising is distributed to the product on a set ratio, which must be determined by the general sales manager. No definite rules or principles can be established to cover the distribution; it remains a matter of keen executive judgment based on analysis of the costs in each case. In this case also the advertising will add prestige to the concern. As a whole this fact should be taken into consideration.

Where advertising is used to offset severe competition, and as such merely to maintain sales volume rather than increase it, the expenses involved should be distributed to all products sold on a pro-rata basis. The basic purpose for distributing advertising costs to the products is to enable the accountant to set up an individual profit and loss account for each product so as to determine those which sell at a profit and those which are sold at a loss to the company.

General advertising expenses may be prorated on the basis of the several items advertised, but those products not advertised should bear no portion of the advertising expense. Special care must be exercised when an advertising drive or campaign is inaugurated to stimulate sales or when extraordinary

expenses are incurred in introducing a new product. Such costs may be spread over several cost periods in order to prevent burdening the cost of sales with the full amount at any one cost period and may be set up in the general ledger as a deferred asset, clearly labeled, and held for a short time only. However, it is usually very unwise to capitalize this type of cost although future benefit may be anticipated as a result of the advertising campaign.

The cost of advertising literature may be capitalized while such literature is in the hands of the company, but as that literature is sent to customers and dealers the cost of same must be distributed to the appropriate account in the classification.

Certain advertising and sales promotional expenses may be legitimately capitalized where it is definitely known that those specific expenses will result in sales in a following period. The reason for capitalizing such costs is to permit their distribution to the cost of the sales derived from that advertising effort, thus enabling the accountant to determine a more or less accurate profit on those specific items.

In determining unit cost, such as the unit cost of demonstrations, it is a simple matter to divide the number of persons in attendance into the total cost of the demonstration, which will give the unit cost per person.

## CHAPTER 28

### CONTROL OF GENERAL ADMINISTRATIVE COSTS

The function of management consists of three primary phases, that of administration which is the formulation of the objective, policy determination, direction, and control; that of execution, or the executive function, which is the carrying out of the objective, and putting into effect the policies thus laid down by the administrative function; and that of staff or the staff function which is purely advisory in nature. General administrative expense includes the cost of functions, not exclusively administrative in nature. The grouping of activities under the heading of general administration is merely an expedient to aid management in accumulating costs and analyzing them systematically.

**Accounting Treatment of General Administration.**—It is a fundamental principle of good accounting to charge a specific activity with the cost of the services rendered to that activity. In the cases of manufacturing and marketing, where management concerns itself with specific activities, the cost of such management should be charged to those activities. As a rule, the administrative function renders services not to any specific phase of business activity but to the business as a whole. Therefore, it is not possible to charge the cost of this function directly to the specific activities of the enterprise. A separate account classification to which the cost of the administrative function may be charged is therefore necessary.

**Divisions of General Administrative Activity.**—To facilitate the collection and distribution of their costs the activities of the general administrative function are classified as follows:

General Administrative Expense  
Comptroller's Department Expense



Treasury Department Expense  
Legal Department Expense  
Industrial Relations Department Expense

The divisions shown above are for the most part in accord with the physical plan of organization shown on the chart on page 26. In most instances the legal department is a staff division under general administration. The work of the comptroller is not always regarded as administrative. The cost accounting section is often considered a part of the factory administrative costs. The other divisions of the comptroller's department serve the entire organization and their costs are not subject to specific allocation against either manufacturing or marketing. There may be exceptional instances where certain services are rendered exclusively to one of these main activities. In such cases, the cost is charged to the activity.

In connection with the division of industrial relations, it will be noted that the cost of certain phases of this work, namely, plant employment, training, and medical service, are charged as a part of the cost of factory administration. It may be that a portion of the work performed by these sections should be charged to general administration if it is practicable to do so.

Likewise, other phases of industrial relations work, such as recreation and education, usually include the personnel of manufacturing and marketing departments, but in most cases it is very difficult to make a separation of these costs in order to make specific charges to either of the activities.

Another point of view is that these activities are not altogether necessary in the conduct of the business, and that the manufacturing or marketing departments have no control over them. Therefore, it is argued that it would be improper to make these departments bear a charge for activities which are not under their control.

The theory underlying industrial relations work outside of the specific activities charged to factory administrative costs, holds that the conduct of these activities is beneficial to the company as a whole. Therefore, it would appear that such

activities as education, recreation, and welfare properly belong to the general administrative function, and that their costs should be charged to general administration.

**Classification of General Administrative Accounts.**—To facilitate the collection and distribution of the detailed costs of administration, it is desirable to establish a classification of accounts to which may be charged the individual items of expense incurred in conducting each phase of this function. The following classification, although not all-inclusive, is representative of the accounts usually found covering the activities of the general administrative function.

**Classification of General Administrative Expense.**—

Salaries of General Administrative Officers and Executives

Clerical

Stenographic

Mail and Messenger Service

Office Supplies

Postage

Printing and Stationery

Telephone and Cable

Traveling Expenses

Entertainment

Insurance

Light, Heat, and Water

Maintenance of Equipment

Maintenance of Buildings

Fixed Charges

Donations

Premiums on Fidelity Bonds

Dues and Subscriptions

Patent Expense

Termination of Employees' Services

Directors' Fees

Pensions and Retirements

Cancellations of Contracts, Options, and Agreements

Automobile Uses

- Education
- Recreation
- Welfare
- Tabulating Machine Rentals
- Suggestion Contests
- Miscellaneous

**Difficulty in Obtaining Detailed Costs of General Administration.**—Only within recent years has the cost department been permitted to set up a detailed classification of administrative expenses. The administrative officers and executives viewed the subject of administrative expenses as a matter concerning only themselves. They may be favorably disposed to cost analysis and control of manufacturing and marketing costs; they believed that their judgment of administrative expenditures should not be questioned and, therefore, the expenses are usually charged as a total sum to an administrative account. The point of view is changing among progressive executives who now regard the detailed recording and analysis of administrative costs with as much favor as they exhibit toward the conduct of this work for other phases of the business. The change is not general and the cost accountant will many times find himself restricted in setting up such a classification as outlined above, and if permitted to set up the classification, he may not be allowed to make an analysis or investigation of any particular account. The accountant should be regarded as a man capable of trust and responsibility and, therefore, should be assisted in all necessary ways to establish and maintain administrative expense control.

**Analysis of General Administrative Expenses.**—Many of the accounts have been discussed in previous chapters, and the process of analysis should be carried on in a similar manner when these accounts are being considered. There are some accounts under the above classification which, although similar to accounts previously discussed, will require different treatment.

**Salaries of General Administrative Officers and Executives.**—This account is charged with all salaries of officers and other executives in the general administrative offices, including the salary of the general manager. The work of an executive is not subject to the same degree of measurement as is that of factory or clerical work. The long-time results of executive effort must, therefore, form the basis for justifying the cost of their work.

**Clerical.**—This account covers the cost of clerical work throughout the administrative offices. The cost of this work is likely to fluctuate considerably, and therefore must be checked carefully. Changes in salary rates and number of clerical workers are the two most common reasons for fluctuations in this account. The first needs no discussion.

The change in the number of workers is frequently unjustified on the basis of the work to be performed. The reason for increasing the personnel may be due to a lack of planning and scheduling the work, or inability to measure the output or to control the efforts of the clerical force. Most offices are overmanned rather than short of the needed amount of clerical help. This also may be due to the fact that executives do not like to suffer any inconvenience or be bothered with any work which can be handled by clerical labor. This is a sound principle, but many times it is overworked.

By comparing the cost over different periods, checking up on changed working conditions, the introduction of labor-saving devices, and increases in work, the detailed reasons for the change in costs may be found. Where work is varied and intermittent, the output cannot be easily measured. In the comptroller's department certain accounting work, billing, and record keeping, indexing, a part of filing, and other work, may be accurately measured. In such cases the analysis should determine the causes of fluctuations.

Frequently the cost of the clerical labor used in billing is charged direct to the sales department. There is a portion of the cost of payroll labor chargeable to general administration, but this payroll work will usually be performed in the treasury

department and thus will be included under the cost of general administration.

**Stenographic.**—This account embraces the cost of all stenographic, typing, and duplicating labor other than the cost of clerical work mentioned in the preceding paragraph. Where all of the stenographic work is centralized the costs are accumulated for the section. Where the work is partly decentralized and certain officers or executives have private secretaries in addition to using the centralized stenographic section, the cost of the private secretaries is charged direct to the activity served.

An analysis of the cost of the stenographic labor will reveal but little unless accompanied by an analysis of the work and work methods. This is difficult to obtain without close supervision and check-up of the work performed. Outside personal work, personal letters where duplicated letters should have been used, stenographic workers utilized for messenger, junior clerical, and other services, increases unnecessarily the cost of stenographic labor. The analysis must, therefore, consider the costs in relation to the work accomplished.

**Mail and Messenger.**—This account includes the cost of collecting and distributing incoming, outgoing, and interdepartmental mail; the non-clerical work of the mailing department, such as wrapping bundles and packages, operation of sealing, stamping, addressing machines, and the cost of such messenger service as is required by the general administrative divisions. The account should be more or less constant, but needs analyzing at intervals to determine if the cost of doing the work is in keeping with the services rendered or required. Frequently, the checking up of this account leads to a study of methods of accomplishing the work more economically, such as the installation of mailing devices, internal communicating systems, or better planning and scheduling of the work in an effort to reduce the number of persons required to perform the various tasks or to provide better service.

A small amount of mail and messenger service may be extended to the factory, but it is impracticable to make a division of the costs, and the total amount is, therefore, charged to general administration. In cases where messengers are assigned to the factory, the cost of this service is charged to factory administration. The sales and advertising departments receive more of this service than the plant, and it is, therefore, desirable to charge them with a portion of the cost of mail and messenger service.

**Office Supplies.**—This account includes the cost of the ordinary supplies used in the office, such as carbon paper, pencils, pens, erasers, clips, rulers, blotters, etc. Waste and extravagance often cause unwarranted fluctuations in this account.

Careful supervision and education of the employees to be economical in the use of supplies are the most effective means of keeping the cost of office supplies at a reasonable figure.

**Postage.**—This account is self-explanatory. It is subject to accurate control through the use of mailing machines. Otherwise, the account is likely to fluctuate due to carelessness in the use of postage, theft of stamps, and personal mail. As in the case of other accounts the cost of postage should be distributed, where possible, according to the division or department consuming it.

**Printing and Stationery.**—This account includes the cost of all letterheads, interdepartmental stationery, printed forms, accounting books, office manuals, house organs, etc. The account will seldom remain constant for any length of time, and due to the high cost of printing and stationery it must be kept under careful supervision. The analysis of this account will be very difficult since it must include a study of the reasons for new forms and changes of existing forms. This is a long and expensive task at times. It may prove well worth doing, for the introduction of additional forms, and records, may be the basis for requiring additional office help, new office machinery, or equipment, or it may hamper the performance of necessary work. Careful analysis, control, and check-up of all forms,

systems, and procedure, as well as careful purchase, storage, and issue of printing and stationery are essential to the control of this account.

**Telephone and Cable.**—This account includes the cost of all outgoing telephone calls, rentals, trunk lines, and telephone equipment, telegrams, and cables and the cost of the internal communication systems as well. The account will fluctuate considerably from period to period and cannot be definitely controlled. The analysis will concern itself largely with the cost of telegrams and toll telephone calls, particularly overtime messages.

Making an analysis of the toll calls and overtime consumed in toll calls often helps to reduce telephone expense by bringing to the attention of the executives the amount involved in long distance calls and overtime. In most cases the telegraph is cheaper and just as effective. Because the telephone is more convenient, executives are disposed to forget the higher cost of its use and use the telephone to excess for long distance communication.

Employees should be provided with pay station booths for personal use. However, unless definite restrictions are set up as to the time when personal telephone calls may be made, much productive time will be lost.

Where possible, the cost of the telephone and telegraph service should be charged to the divisions using these services. The operator records all outgoing calls by extensions. This forms an accurate basis for making the charge against the departments or divisions making the calls.

**Traveling Expense.**—This account embraces the cost of necessary travel by the various executives. Railroad, steamship, airplane, fares, hotel accommodation, tips, taxis, and other expense. The account will vary widely from period to period and is not subject to comparison. The fact that it is restricted to the use of the general executives theoretically precludes the possibility of excessive charges, and consequently it will need no analysis.

**Entertainment.**—Included in this account is the cost of entertaining executives of subsidiary companies, representatives of other companies, and visitors. When the account is restricted to executive use it should not be abused and would, therefore, require no analysis. It is assumed that this account will represent only such expenditures as the executives deem necessary in the interests of the company. Instances are known where this entertainment privilege has been abused, but the matter is subject to executive discretion in all cases.

**Insurance.**—This account includes the cost of premiums on such life or accident insurance as may be carried by the company on its executives. The account will be practically static, and no analysis will as a rule be made. The Insurance account shown under the fixed charges heading, which includes the cost of protection, employer's liability, etc., should not be confused with this account.

The following accounts have been treated in previous chapters and require no further discussion:

- Light, Heat, and Water
- Maintenance of Equipment
- Maintenance of Buildings
- Fixed Charges

**Donations.**—This account includes such gifts to charity, church, civic projects, employees' families, clubs, and organizations as the management may see fit to make. The account will fluctuate but needs no analysis since it is a matter of executive determination.

**Premiums on Fidelity Bonds.**—This account covers the premium cost on bonds issued in favor of the company to protect them against dishonesty of employees in trusted positions. The account will fluctuate only with changing rates of premiums and the issue or cancellation of bonds. An analysis would be made only for the purpose of determining the necessity or desirability of increasing, decreasing, or discontinuing the bonds on various employees.



**Dues and Subscriptions.**—The cost of dues to various organizations, both industrial and social, of which the executives deem it advisable to be members, and also the cost of subscriptions to magazines, periodicals, services, etc., which are beneficial to the management, form a charge against this account. Like others previously discussed, this account is a matter of executive determination.

**Patent Expense.**—The cost of patents which it is not desirable to capitalize, cost of patent litigation, and investigations concerning infringement on patents are chargeable to this account. The cost of such patents as are capitalized becomes a part of the capital assets and are, therefore, not included. The legal nature of patent work makes an analysis of this account of little value. However, it does aid in control and comparison of these expenses.

**Termination of Employees' Service.**—The amount of salary paid to employees terminating their services upon request is charged to this particular account. It represents the policy of the company toward the employees, and is regarded as an investment in good-will and fairness to them. This policy usually applies to executives and office employees and as a rule the account will need no analysis. In some instances, where the amount seems excessive in a given department, it is desirable to analyze it in connection with the previous rates of turnover, working conditions, or management of the department.

**Directors' Fees.**—Charge this account with the fees paid to directors for attending directors' meetings.

**Pensions and Retirement.**—Charge this account with all pensions paid to employees on the retired list and the percentage of administrative payroll required under the Social Security Act.

**Cancellation of Contracts, Options, and Agreements.**—To this account are charged the expenses involved in the cancellation of contracts, options, or agreements. Oftentimes, a contract is entered into, an agreement made, or an option taken

which it is not desired to exercise. When a company pays to be released from an agreement or contract this account is charged with the amount paid. An account of this nature will fluctuate and will need periodic analysis. The analysis should be made primarily for the purpose of shedding light upon the necessity or desirability of cancelling contracts or options, and also to assist in judging executive wisdom of entering into such contracts or agreements.

**Automobile Uses.**—This account is charged at a mileage or hourly rate with the cost of operating automobiles in service of the various executives. The account will vary and the analysis will be made to determine the economy and necessity of automobile usage in connection with the official business of the company.

**Education.**—This account is charged with the cost of space, fixed charges, teaching, instruction, books, and library service in connection with educational work carried on for the benefit of the employees other than direct training activities. The character of educational work carried on will determine the extent of fluctuation in this account. The analysis of the account should consider the expenditures in the light of the determinable benefits arising therefrom. The economy of the use of the money allowed for educational work must be checked. Lack of interest, improper selection of the educational program, and lack of facilities for carrying out the program bear directly upon the results or benefits secured from the work.

Often the analysis will develop the fact that the instructional work can be accomplished more cheaply and more effectively by outside institutions than by company executives. The educational work, like the two accounts immediately following, is under the supervision of the industrial relations division. Its costs are charged to general administration although the personnel of the entire company benefits therefrom. This accounting practice is followed because of the difficulty and expense of prorating the cost of education to the various divisions of the company.

**Recreation.**—This account is charged with the cost of trips, outings, athletics, library facilities, and clubs. The recreational program will, of course, vary from period to period, and the expenditures for this purpose will likewise vary. The theory underlying this work is the same as that for educational work and the analysis must be made each period for the same reasons and in the same way. This account may permit of some abuse which should be brought to light through its analysis.

**Welfare.**—To this account are charged a variety of items. The costs of visiting nurses, convalescent homes, legal advice to employees, property appraisals for employees, Americanization, dormitories, lunchrooms, etc. The welfare work is designed to stimulate the employees, build up their loyalty and fidelity to the company, and reduce the cost of labor turnover. Indirectly, the quality and the quantity of output and the goodwill of the company are affected by this work.

The Welfare account should be viewed in the same light as educational and recreational accounts, and should be analyzed in the same manner and for the same reasons. The analysis leads into basic company policies, relates also to selection of the employees, working conditions, wage systems, and many other fundamental aspects of management. A large proportion of the benefits derived from welfare work are not directly measurable and the expenditures therefore are frequently questioned. The long-time effects and benefits are more to be considered than the immediate gains. The management must, therefore, view the subject as one of development, and this view must be retained in analyzing the cost of the work and comparing the costs with the benefits.

**Miscellaneous.**—There is no good reason for the existence of this account. All items of administration expenses should be allocated to one of the accounts suggested in the classification. However, in practice, many small expenditures occur for which the classification makes no provision except through the miscellaneous account. It should be watched very carefully since it may be made a dumping ground to cover up unwarranted items of expense.

Financial expense or the cost of money is not generally considered as administration expense but it is deducted directly from profit and loss.

**Disposition of Administrative Expense.**—The cost of management in the average business represents a substantial sum of money. If general administrative costs are to be controlled, an accounting classification must be set up showing the detailed accounts to which the varied expenditures of administration should be charged. Furthermore, the cost accountant or comptroller must have the permission and the assistance of the executives in analyzing the costs of general administration.

The ultimate disposition of the costs of general administration is to charge them to "Cost to Make and Sell." This charge may be made as a total sum with a supporting schedule showing details attached to the financial statement, or it may be made according to a major or detailed classification of items also attached to the financial statement. Usually administrative expense is shown on the profit and loss statement as a deduction appearing after the item, sales expense.

## CHAPTER 29

### GENERAL ACCOUNTING PROCEDURE

**The Purpose of Accounting.**—Accounting may well be defined as the science of recording and analyzing business transactions in such a manner that a clear, concise, and accurate statement of the current position of the enterprise can be ascertained at any given time.

Accounting is a tool of management through which many standards may be established, the efficiency of the business progress determined, the results of operations measured, and forms a basis for preplanning the course of the business progress.

The purpose of accounting is to record all business transactions in a systematic way so as to provide management with reliable data upon which may be formulated plans and policies for the successful direction, operation, and control of the business enterprise.

There are various methods used to record business transactions, but the two common forms are known as single and double entry bookkeeping. Inasmuch as single entry bookkeeping is not practiced to any great extent in the business world today it is deemed desirable to discuss only accounting in the form of the double entry system.

**The Double Entry System.**—In the double entry system a separate and distinct account is established on the books for each class of merchandise, property, and persons. The underlying principle of the system is, as the name implies, that there must be at least two entries made for each transaction which takes place; one of which is made to the debit side of one account, and the other to the credit side of some other account. It is obvious that the sum of this debit entry must be equal in amount to the sum credit entry.

Every business transaction invariably affects at least two things: it alters the properties or debts of the concern, or both, or it changes the ownership. If, for example, cash is received for merchandise sold, two property or asset accounts are affected, namely, the Cash account and the Merchandise account. If cash is paid out to satisfy a vendor's invoice, an asset account and a liability account are affected. Again, if a note is given to a vendor instead of cash, two liability accounts are affected, "Accounts Payable" is debited for the value of the note and the account, "Notes Payable" is credited for a similar amount.

It, therefore, becomes apparent that in this system of accounting, each time an account is debited with an amount of money, some other account or accounts must be credited with a similar amount.

**Books of Original Entry.**—A book of original entry is one in which the details of each transaction are first recorded, such as a purchase journal or cash journal. One cannot lay too much stress on the fact that all entries in the books of original entry should be accurate, neat, and in proper chronological order, free from alterations or erasures, as these books are the only records admitted in the courts of law as evidence, for or against a customer, vendor, or the company. It is only natural that if these books are irregular and show traces of omissions, alterations, or erasures, their value as legal evidence is limited, if not rendered wholly worthless.

Great care should be exercised in making entries on the books of original entry since all errors made in these books will be reflected in the other ledgers.

**Account Defined.**—An account is a formal, systematic statement of the debits and credits which occur under one classification or name, and show the increase or decrease in the value of items represented by the classification. A ledger is a book in which a group of accounts is kept.

To open an account in the ledger means the establishment of a new name or classification within the ledger.

**Classification of Accounts.**—Accounts are generally classified under the main headings, “real accounts” and “nominal accounts.”

1. *Real Accounts.* The term “real accounts” is used to designate those accounts which reflect the financial condition of the business. These accounts show the actual value of assets and liabilities of the concern and formulate a basis for the construction of the balance sheet.
2. *Nominal Accounts.* All accounts which reflect changes in the financial condition of the business are called “nominal accounts.” These accounts show the costs of carrying on business, the expense involved, and the profit or loss sustained as a result of operations. Accounts falling under this particular category form the basis for constructing the statement of income and profit and loss.

By examining the following forms, the student will get some idea of how and why certain entries are posted to these accounts:

CASH ACCOUNT

Debit	Credit
When cash is received place on this side.	When cash is paid out place on this side.

MERCHANDISE ACCOUNT

Debit	Credit
When merchandise is received place value on this side.	When merchandise is given out of stores place value on this side.

ACCOUNTS RECEIVABLE  
(From Customers)

Debit	Credit
When goods are sold to customers enter on this side of the account.	When the customer makes payment use this side of account. If the customer returns goods enter on this side of account.

ACCOUNTS PAYABLE  
(Vendors)

Debit	Credit
When we pay for goods purchased place amount on this side of the account.	When we buy goods from vendor place amount on this side of account.

**The Journal.**—In certain countries in Europe the law requires that all entries should pass through the journal before

being entered in the ledger. However, this idea has been modified, particularly in this country and thus the journal is now used to record only transactions which are outside the scope of other books. In modern accounting practice, summaries of the monthly transactions of the books of original entry pass through the journal and all entries made in the general ledger are posted from journal entries. The journal is the medium from which the general ledger is compiled and in these two books are complete records of the company's accounts. Most of the progressive concerns are using loose-leaf binders for journal entries and this type of journal has many advantages over the old bound book type and permits two or more persons to make out journal entries at the same moment without wasting time. Supporting detailed schedules of journal entries can be attached to the journal entry. (Loose-leaf journal entry forms Figures 40 and 41.)

**The General Ledger.**—The general ledger is composed of controlling accounts, which accounts show in summary form the information kept in other accounts, and should be treated entirely independent of the corresponding subsidiary accounts as carried in the subsidiary ledgers. For example, there is an account in the general ledger known as "Accounts Receivable" and this controlling account will show probably a debit balance which represents the amount of money that all customers owe the concern. The detailed items making up this balance will be contained in the accounts receivable ledger. In other words, the balance of any control account can be checked against a balance obtained from an entirely separate source and in this way a very effective control can be maintained. The general ledger, therefore, contains the controlling accounts which form the media from which the financial statement is derived and compiled.

**The Financial Statement.**—The nature of the information desired for managerial and legal purposes will determine the kinds of accounts to be kept and the method by which the financial data will be given to the executives. The more usual way of presenting financial information to the busy executive



The Glomaze Company, Inc.	
JOURNAL ENTRY FORM	
	Jnl. Entry No. _____
	Month _____
Debit _____	
_____	
_____	
_____	
_____	
_____	
_____	
	Credit _____
	_____
	_____
	_____
	_____
	_____
Particulars _____	
_____	
_____	
_____	
_____	
_____	
_____	
_____	
_____	
_____	
_____	
_____	
Approved _____	Signed _____
Entered _____	

Figure 40. Journal Entry Form



is in the form of a financial statement which is composed of: a balance sheet, a statement of income and profit and loss, and various supporting schedules.

The balance sheet is a statement showing the financial condition of the business and is constructed so that values representing what is owned by the concern are placed on the left-hand side of the balance sheet, and are known as assets; while values representing what is owed by the particular concern are placed on the right-hand side of the sheet and are known as liabilities. The difference resulting between the assets and liabilities is known as proprietorship or capital and is expressed by the capital account or accounts of the owners of sole proprietorships and partnerships and by the capital stock and surplus accounts of a corporation.

**The Trial Balance.**—As soon as all entries have been made in the general ledger for the month, and before the ledger is closed for that month, a list of all the open accounts is made in two columns; one for all debit balances and the other for all credit balances. This list of open accounts is known as the trial balance of the general ledger.

The purpose of this trial balance is to test the ledger, to determine if the open debit accounts are equal to the open credit accounts. If such is the case the ledger is said to be in balance. The trial balance will reveal the presence of errors as regards the relation which exists between debits and credits; it will not reflect compensating errors in both debits and credits.

The trial balance on the following page was taken from the general ledger of the Glomaze Company, Inc.

**Explanation of Ledger Accounts.**—An explanation of the content of each of the accounts shown on the trial balance and the manner in which transactions affecting these accounts are carried through the journal and subsidiary ledgers into the general ledger will assist the student in understanding the methods used in the subsequent preparation of the profit and loss statement and the balance sheet.

## GLOMAZE COMPANY, INC.

## TRIAL BALANCE OF THE GENERAL LEDGER—JANUARY 31, 1937

Acct. No.	Name of Account	Debits	Credits
1	Cash in Bank .....	\$ 30,000.00	
2	Cash on Hand .....	1,000.00	
3	Accounts Receivable .....	252,839.20	
4	Notes Receivable .....	15,000.00	
5	Raw Materials and Supplies .....	174,100.00	
6	Work in Process .....	205,500.00	
7	Finished Stock .....	175,000.00	
8	Consignments .....	5,500.00	
9	Manufacturing Expense .....	1,050.00	
10	Doubtful Accounts Written Off ...	1,345.00	
11	Reserve for Doubtful Accounts ...		\$ 18,460.00
12	Contingent Reserve for Sales .....		10,500.00
13	Consignment Reserve .....		2,000.00
14	Prepayments .....	800.00	
15	Investments .....	50,000.00	
16	Land .....	32,500.00	
17	Buildings .....	65,000.00	
18	Depreciation of Buildings .....	158.00	
19	Reserve for Depreciation .....		15,500.00
20	Machinery and Equipment .....	40,000.00	
21	Depreciation of Mach. and Equip. .	487.00	
22	Reserve for Depr. of Machinery and Equip. ....		12,780.00
23	Furniture and Fixtures .....	5,760.00	
24	Depreciation of Furniture and Fix- tures .....	68.50	
25	Reserve for Depr. of Furniture and Fixtures .....		2,950.00
26	Sales Expense .....	60,100.00	
27	Advertising Expense .....	17,520.00	
28	Administrative Expense .....	19,875.00	
29	Accounts Payable .....		45,400.00
30	Notes Payable .....		27,600.00
31	Accruals (Taxes and Royalties) ..		1,240.00
32	Rebill .....		115.00
33	Interest Earned .....		100.00
34	Labor Accrued .....		3,700.00
35	Sales .....		1,056,400.00
36	Cost of Sales .....	676,820.00	
37	Reserve for Income Tax .....		32,677.70
38	Capital Stock .....		600,000.00
39	Surplus .....		1,000.00
40	Profit and Loss .....		
		<u>\$1,830,422.70</u>	<u>\$1,830,422.70</u>

Figure 42. Trial Balance

Many of the original records which form the bases for journal entries to these accounts are explained in the chapters dealing with the activities, such as purchasing and sales.

**ACCOUNT 1. CASH IN BANK.** This account shown on the trial balance sheet represents the cash which the company has deposited in its various depositories. All incoming money and checks from customers are received by the treasurer, who makes out a cash receipts schedule, a duplicate of which is sent with the customers' checks to the accounts receivable ledger clerk, who uses it to post the receipts of cash to his ledger. At the end of each day, week, or month as the case may be, the cash receipts schedules are summarized and an entry is made in the journal to cover these transactions of cash, which is as follows:

<i>Debit:</i> Cash in Bank .....	\$———
<i>Credit:</i> Accounts Receivable .....	\$———

Each day the treasurer deposits the cash received as per "cash receipts schedule" in the designated bank.

If a customer makes a payment for a note that has matured, this payment would appear on the treasurer's "cash receipts schedule" and in making the journal entry the credit would be applied to "Notes Receivable" and charged to "Cash in Bank." When the treasurer pays out cash to cover a vendor's invoice, the entry would be a debit to "Accounts Payable" and a credit to "Cash."

**ACCOUNT 2. CASH ON HAND.** This account covers the petty cash held by the cashier. This account is generally held at a constant figure and is used by the cashier to pay small freight and express charges and other petty cash vouchers. The various bills are summarized at the end of each week and turned over to the treasurer for reimbursement. A journal entry is made out at the end of each month covering the petty cash transactions, which is as follows:

<i>Debit:</i> Freight, express or cartage, or administrative expense (depending upon the nature of the accounts affected) ....	\$———
<i>Credit:</i> Petty Cash .....	\$———

**ACCOUNT 3. ACCOUNTS RECEIVABLE.** This is the controlling account in the general ledger, covering the control of all customers' accounts in the subsidiary ledgers. A customer sends in an order for goods; this order is given to the sales department where a number of interdepartmental sales orders are made out, one of which is sent to the shipping division as its authority to obtain the goods from stores and make the shipment. As soon as the goods have been shipped, this copy of the interdepartmental sales order is forwarded to the billing section of the comptroller's department, where the customer's invoice is prepared. One copy of the customer's invoice is turned over to the accounts receivable section where it is entered in the accounts receivable ledger under the customer's name. Another copy is forwarded to the sales analysis section of the comptroller's department, where it is entered on the recapitulation of the sales sheet by invoice number and analyzed according to class of sales. Figure 43 shows a typical page in the accounts receivable ledger, while Figure 44 shows a sales analysis sheet. At the end of each day the sales analysis figures should balance with the amount of the invoices added to the accounts receivable ledger for that day.

By the use of this method, a lost or misplaced invoice which has not been entered in the accounts receivable ledger may be located owing to the fact that all customers' invoices are listed numerically on the sales analysis recapitulation sheet. The monthly journal entry is compiled from the vertical additions of the columns on the sales recapitulation sheet. The two columns marked "Ledger 1" and "Ledger 2" are added and form the basis for the journal entry which is a debit to "Accounts Receivable" and a credit to "Sales." A similar sales analysis sheet is made out for all credit invoices and a journal entry is compiled which will be a debit to "Sales" and a credit to "Accounts Receivable." Credit invoices represent decreases of customers' accounts as a result of allowances for returned merchandise, damaged goods, shortages, and like items.

As explained on page 525, the monthly summary of cash receipts is journalized as a debit to "Cash" and a credit to "Accounts Receivable."



ACCOUNT 4. NOTES RECEIVABLE. A customer who buys goods either pays for them by cash or by a negotiable instrument. If the customer pays by note, it may either be discounted by the company or retained by it until the date of its maturity. In the latter case, a journal entry would be made to cover this transaction which would read as follows:

Debit "Notes Receivable" and credit "Accounts Receivable" for the amount of the note. When the note matures the customer sends in his check for the amount of the note and interest thereon to the treasurer, who records it on the cash receipts schedule. The journal entry in this case would be as follows:

*Debit:* Cash in Bank (for the total amount of  
the note and interest) .....\$——

*Credit:* Notes Receivable (for the amount of  
the note only) ..... \$——

Interest Earned (33) (for the amount of  
the interest on the note) ..... \$——

ACCOUNT 5. RAW MATERIALS AND SUPPLIES. This account represents the value of the inventory of raw materials and supplies held in the storesroom of the company. Raw materials are purchased by the purchasing department on authorized requisitions from the material control section. When these materials are received they are inspected and placed in the storesroom. The vendor sends his invoice for the materials purchased to the purchasing department of the vendee, where it is checked and forwarded to the accounts payable section of the comptroller's department. These invoices are listed in the accounts payable ledger (which will be explained under "Accounts Payable" 29). At the end of each month an analysis is made of the various vendors' invoices and those which cover raw materials and supplies are listed under that heading in the purchase analysis.

The total of the materials and supplies column when added forms the basis for debiting the account "Raw Materials and Supplies" with the value of the materials purchased during the month and a corresponding amount will naturally be credited to "Accounts Payable." When materials are given out of the stores on properly authorized requisitions, these requisitions



when summarized form the basis for the journal entry which reads as follows:

Debit "Work in Process" (6) (where the materials are being used to produce a finished product), or "Manufacturing Expense" (9) (where the materials are being consumed in an accessory manner to the manufacture of the product), or to any other account where the material is used, such as the "Cost of Sales" (37) and credit "Raw Materials and Supplies" with the cost of these materials.

Materials which are not consumed are returned to the stores-room on a "credit slip." The journal entry in this case would be: Debit "Raw Materials and Supplies" (5) and credit "Work in Process" or other accounts, with the value of the materials returned.

It must be remembered that there are subsidiary ledgers kept by the material control division in which a separate account is set up for each individual class of material. Daily the material requisitions are priced, extended, and entered in the subsidiary ledgers, from where they are forwarded to the cost department as they form the basis for the material cost of the manufactured products.

The chief accountant is responsible for seeing that the "Raw Materials and Supplies" controlling account is in balance with the subsidiary materials and supplies ledger.

**ACCOUNT 6. WORK IN PROCESS.** This account represents the value of material which is in the course of progress through the factory and before it has been turned into a finished product. Theoretically the only way that charges are made to this account is by means of the material requisition, labor ticket, transfer ticket and applied or actual manufacturing expense. However, occasionally purchases of materials are made for special operations or job orders, which materials are immediately put in process without passing through the stores. In such cases the cost of these materials will be recorded in the purchase analysis, from which they will be picked up by the cost division and posted in the subsidiary work in process ledger. Through the monthly summary of the purchase analysis the

value of this material will be posted as a debit to the "Work in Process" account in the general ledger.

The subsidiary ledger of work in process is kept in the cost division. This ledger contains accounts for the various job, shop, and manufacturing orders. Materials are drawn from the storesroom on properly authorized requisitions, which requisitions show the production or job order number for which the materials are being used.

The material ledger clerk prices and extends these requisitions daily, makes the necessary deductions for the materials given out on his ledger, and forwards these requisitions to the cost division. The cost clerk posts the requisitions in his work in process ledger to the various accounts affected. At the end of each month he summarizes all material requisitions and credit slips and prepares a journal entry, attaching to it a copy of the materials summary. This entry reads as follows: Debit "Work in Process" and credit "Raw Materials and Supplies" with the cost of the materials drawn from stores.

As a general rule, materials passing through the process of manufacture require labor to convert them into the finished product. Each employee upon entering the company is given a clock number and card. He punches the time clock upon entering or leaving the plant. This clock card forms the basis for compiling the payroll, with the exception of those employees who are on piece work, under which conditions the labor tickets are used. The shop timekeepers make out time tickets for each worker for each job performed.

These time tickets are priced and extended by the payroll department, checked against the payroll and sent to the cost division. The cost clerk posts these time tickets to the various accounts in his Work in Process ledger. Each week the paymaster makes up a summary of the labor tickets for which an accounts payable voucher is made out, which he presents to the treasurer, or bank, for the cash to pay the employees. (See "Labor Account" 35.)

Through the journal entry covering the purchase analysis for the month in question, the labor is debited to "Work in Process" and credited to "Accounts Payable." It can be seen

that in the summary of the vouchers on the cash disbursement sheet, "Accounts Payable" will be debited for the amount of the payroll and "Cash in Bank" will be credited for a similar amount.

In addition to the direct labor required to complete a product, a certain amount of accessory or service labor is necessary, such as supervision. Power to supply the motive force, accessory materials such as oils and cotton waste and maintenance of the machinery are also necessary to manufacture a finished product. These items are known as manufacturing expense and the cost of which must be added to the Work in Process account in order to obtain the cost of the completed products. Many concerns have figured out a ratio of manufacturing expense to direct labor and apply this percentage to all direct labor expended in the manufacturing process, in order to absorb the manufacturing expense incurred. Under this particular plan all indirect or service material and labor would be charged to the Manufacturing Expense account, through monthly material requisitions summary, the payroll summary, and the purchase analysis. The cost clerk determines the amount of direct labor expended on each job, calculates the amount of manufacturing expense absorbed based on the standard ratio and makes out a journal entry, which reads: Debit "Work in Process" and credit "Manufacturing Expense" for the amount of the absorbed manufacturing expense. It must be remembered that the appropriate amount of manufacturing expense is entered on each account in the work in process subsidiary ledger so as to determine cost of each job, manufacturing, or shop order.

The subsidiary ledgers in the cost department must balance with the controlling account of "Work in Process" in the general ledger.

**ACCOUNT 7. FINISHED STOCK.** This account represents the cost of the stock in the finished storesroom. As soon as the various work in process orders have been completed, the cost clerk makes out a journal entry charging the Finished Stock account and crediting the Work in Process account with

the cost of the products transferred from the shop to the finished storesroom.

**ACCOUNT 8. CONSIGNMENTS.** This account represents the selling price of merchandise which is sent to a customer on consignment. The sales analysis clerk posts all invoices marked "consignment" in the consignment column of the sales analysis ledger, so that at the end of a month the sales analysis journal entry will show a charge to the Consignment account and a credit to "Sales" for this particular transaction (see sales analysis on page 527). If the customer returns this merchandise, the procedure with reference to this entry is reversed.

**ACCOUNT 9. MANUFACTURING EXPENSE.** This account represents the amount of manufacturing expense incurred during the cost period in the production of goods. As explained under the Work in Process account, material requisitions, labor tickets, and accounts payable vouchers having charges for expenses are entered in this account through their appropriate journal entries. The cost clerk makes out a journal entry crediting "Manufacturing Expense" for the value of expenses applied to and on the products for the cost period.

Inasmuch as manufacturing expense is applied to the products on a ratio basis, the account will seldom be cleared out at the end of a month. There will be either an over- or under-absorbed expense remaining in the account which the accountant will transfer to the Profit and Loss account by his adjusting entries.

**ACCOUNT 10. DOUBTFUL ACCOUNTS WRITTEN OFF.** This account represents the value of uncollectible accounts which are over ninety days old. The accounts receivable ledger bookkeeper makes an analysis of the accounts receivable, as explained under Account 3, and all customer accounts which are over ninety days old, and authorized by the "credit and collections division," are journalized as follows: Debit "Doubtful Accounts Written Off," and credit "Accounts Receivable."

At the end of the fiscal year this account is cleared to the "Reserve for Doubtful Accounts." Should any amounts be collected after the account is written off, an entry is made debit-

ing "Cash" and crediting "Collections from Doubtful Accounts Written Off."

ACCOUNT 11. RESERVE FOR DOUBTFUL ACCOUNTS. This account represents a fixed proportion of sales, based upon past experience, which is set aside to protect the company against the non-payment of bills by customers.

Each month a journal entry is made out by the general ledger bookkeeper charging Sales Expense (subsidiary account "Provision for Bad Debts") and crediting this reserve with the agreed-upon percentages of sales.

ACCOUNT 12. CONTINGENT RESERVE. This account represents an amount set aside, based upon past experience, to take care of contingencies. This provides for possibilities such as when products are guaranteed to give service for a certain number of years and, through some defect in the product, do not last their guaranteed life and are returned by the customer to the company. A provision should be made to take care of the cost of reconditioning these products.

The general ledger accountant is responsible for making a journal entry debiting "Manufacturing Expense" and crediting "Contingent Reserve" with an amount sufficient, according to previous experience, to cover these returns on the probable allowances which will be claimed by the customer under the terms of the selling agreement. The account will be debited with the allowances given to the customers during the month under the selling terms and credited to "Accounts Receivable."

ACCOUNT 13. CONSIGNMENT RESERVE. This account represents a reserve equal to the difference between the sales price and the cost of merchandise shipped to customers on consignment.

Goods sent to customers on approval are naturally billed at the sales price. Inasmuch as the sales price includes profit, a consignment cannot be set up on the asset side of the balance sheet without an appropriate reserve being set up on the liability side of the balance sheet which will reduce it to cost, or it may be set up on the asset side and subtracted from the

Consignment account. The following journal entries are necessary to cover merchandise shipped on consignment:

## No. 1

<i>Debit:</i> Accounts Receivable (Sales Price) .....	\$100.00	
<i>Credit:</i> Sales Consignments (Sales Price)....		\$100.00

## No. 2

<i>Debit:</i> Consignments (Sales Price) .....	\$100.00	
<i>Credit:</i> Finished Stock (Cost).....		\$ 60.00
Consignment Reserve (Difference)...		40.00

ACCOUNT 14. PREPAYMENTS. This account represents expenditures which are made and the benefits of which extend over two or more accounting periods, such as insurance.

It is apparent that such expenditures covering future services or benefits should not be included in the figure of the current accounting period but should be prorated over the periods which it covers. Assume, for instance, that the insurance premium for one year is \$240.00 which covers the protection of buildings in case of fire.

This amount should be prorated over the twelve months. The invoice covering the insurance premium will appear in the purchase analysis under the heading of "Prepayments." Through the monthly journal entry of the purchase analysis this item will be charged to the Prepayments account in the general ledger. The general ledger accountant in his closing journal entry will include the following entry:

<i>Debit:</i> Manufacturing Expense—Insurance 1/12 of \$240.00 .....	\$20.00	
<i>Credit:</i> Prepayments—Insurance .....		\$20.00

ACCOUNT 15. INVESTMENTS. This account represents the amount of the company's funds invested in government or other reliable securities.

<i>Debit:</i> Investments .....	\$———	
<i>Credit:</i> Cash .....		\$———

ACCOUNT 16. LAND. This account represents the cost of land purchased by the company.

ACCOUNT 17. BUILDINGS. This account represents the cost of erecting or purchase of buildings.

ACCOUNT 18. DEPRECIATION OF BUILDINGS. This account represents the estimated loss in the value of buildings on account of use, wear and tear, and the passage of time. As explained in the chapter on cost accounting, assets such as buildings, machinery, etc., lose value and therefore, this loss must be charged to the cost of manufacturing.

Depreciation is based on the estimated life of a building. Assume, for instance, that a building cost \$65,000.00 (as shown in the trial balance, Figure 42) and the estimated life is 34 years, which means that the estimated depreciation would be \$1,896.00 per year. The general ledger accountant makes out a journal entry at the end of each month to cover one-twelfth of the amount of depreciation.

<i>Debit:</i> Depreciation of Buildings .....	\$158.00
<i>Credit:</i> Reserve for Depreciation of Buildings .....	\$158.00

The monthly adjusting entry will close out the Depreciation account and will be as follows:

<i>Debit:</i> Manufacturing Expense—Depreciation of Buildings .....	\$158.00
<i>Credit:</i> Depreciation of Buildings .....	\$158.00

ACCOUNT 19. RESERVE FOR DEPRECIATION OF BUILDINGS. This account represents the amount set aside each month to replace buildings which have served their usefulness or may be considered as a valuation account and as such, it is deducted from the amount in the Buildings account, thus reducing the cost of buildings to their present estimated value. The reserve is equal to the amount of the depreciation charged to "Manufacturing Expense" over the life of the asset. (See journal entry explained under "Depreciation of Buildings.")

ACCOUNT 20. MACHINERY AND EQUIPMENT. This account represents the cost of installed machinery and equipment which is used to manufacture the products.

ACCOUNT 21. DEPRECIATION OF MACHINERY AND EQUIPMENT. This account represents the estimated loss in value of

machinery and equipment owing to use, wear and tear, and the passage of time. The treatment of this account is similar to that explained under Account 18.

**ACCOUNT 22. RESERVE FOR DEPRECIATION OF MACHINERY AND EQUIPMENT.** This account represents the amount set aside each month to replace such machinery and equipment as has served its usefulness. It is also considered a valuation account, the amount of which may be shown on the asset side of the business sheet and deducted from the amount of the Machinery and Equipment account, the difference representing the present estimated value of the machinery and equipment. (See Account 19.)

ACCOUNTS 23, 24, AND 25 are similar in treatment to Accounts 17, 18, and 19, with the exception that they represent furniture and fixtures instead of buildings.

**ACCOUNT 26. SALES EXPENSE.** This account represents the amount of money expended to sell the products. Such items as salaries of salesmen, salaries of sales office employees, rent of sales offices, etc., are charged to it.

**ACCOUNT 27. ADVERTISING EXPENSE.** This account represents the amount of money expended in advertising the products. Such items as salaries of employees engaged in advertising work, cost of billboard space and advertising copy are charged to this account. "Advertising Expense" is a part of "Sales Expense."

**ACCOUNT 28. ADMINISTRATIVE EXPENSE.** This account is charged with the cost of general administration and includes such items as salaries of executives, cost of operating the mail and messenger service, clerical help in the administrative office, etc.

**ACCOUNT 29. ACCOUNTS PAYABLE.** This account is a controlling account on the general ledger and represents the total amount of money owed to creditors. The total of this account is supported by individual vendor accounts on the subsidiary accounts payable ledger. For instance, a quantity of raw material is purchased on an authorized purchase order,



The Glomaze Company, Inc. PURCHASE ANALYSIS													
DATE 1933	VOUCHER NO.	NAME OF VENDOR	DATE PAID	AMOUNT	RAW MAT- ERIALS & SUPPLIES	WORK IN PROCESS	MANUF'G EXPENSE	PRE- PAYMENTS	MACHINERY & EQUIPMENT	FURNITURE & FIXTURES	SALES EXPENSE	ADMINIS- TRATIVE EXPENSE	
Jan. 5	1	William Brown & Co.	1/6	150.00	100.00		50.00						
" 5	2	The Revolv. Co.	1/6	2,000.00					1,500.00	500.00			
" 5	3	The Erma Ins. Co.		240.00				240.00					
Jan. 8	4	R.W. Ryan	1/8	40.00							40.00		
" 8	5	S. Weldon	1/20	450.00	450.00								
" 8	6	John Archer Co.	1/9	125.00							25.00	100.00	
Jan. 15	7	Payroll	1/15	3,760.00		1,200.00	950.00				800.00	810.00	
" 15	8	The Hoop Co.	1/18	1,780.00	1,780.00								
" 15	9	James D. Meinland Co.		315.00			115.00				100.00	100.00	
Jan. 22	10	Dave Pierce & Co.	1/22	1,832.00					1,832.00				
" 22	11	The Brown Co.		240.00	240.00								
" 30	12	The Revolv. Co.	1/30	1,641.00					1,641.00				
" 30	13	Payroll	1/30	3,895.00		1,275.00	980.00				840.00	800.00	
	14												
TOTAL				16,468.00	2,570.00	2,475.00	2,095.00	240.00	4,973.00	500.00	1,805.00	1,810.00	

Figure 45. Purchase Analysis

this order will show the account to which the material must be charged upon its arrival in the plant. When the vendor ships the ordered material he sends in the bill for that merchandise. The bill is sent to the purchasing department where it is verified with the original purchase order and checked against the receiving reports. If it is found to be correct, it is sent to the Accounts Payable section of the comptroller's department where an accounts payable voucher is issued for the amount. It is then posted in the purchase analysis and distributed to its correct account therein, as illustrated on Figure 45.

The vendor's bill is attached to the duplicate voucher and the original voucher serves as a bank check for the payment of the bill, when it is signed by the comptroller and general manager. These vouchers are listed on the cash disbursement sheets, from which the date of payment is entered on the purchase analysis as noted in column 4 (Date paid).

At the end of the month the open items on bills not paid are posted in the accounts payable ledger. The use of this method saves a great deal of time and paper. However, the more conventional method is to post the vendor's invoice directly in the accounts payable ledger and then make up the purchase analysis sheet.

The cash disbursement sheets are summarized at the end of each month and the following journal entry made out:

<i>Debit:</i> Accounts Payable .....	\$———
<i>Credit:</i> Cash in Bank .....	\$———

ACCOUNT 30. NOTES PAYABLE. This account represents the notes which have been given to creditors for service or material. Raw materials and machinery are sometimes purchased from vendors by giving them a note or a promise to pay the amount of money at a certain time, with interest. The usual journal entry will be—Debit Accounts Payable and credit Notes Payable.

ACCOUNT 31. ACCRUALS. Items such as taxes and royalties are usually billed to the company every six months. In order that the books may show the true financial condition of the company at the close of each accounting period, it is neces-

sary to set up all liabilities which have accrued. The exact amount of taxes or other items may not be known, under which circumstance the items must be estimated and set up in general ledger. The usual journal entries to this account are:

*Debit:* Manufacturing Expense (with the monthly  
estimated value of taxes, etc.).....\$——

*Credit:* Accruals (taxes, etc.).....\$——

As soon as these bills are rendered, debit "Accruals" with actual value of the items and credit "Accounts Payable." If a balance remains in the account after the amount of the tax bill, etc., is posted, it is either a debit or a credit to "Manufacturing Expense."

ACCOUNT 32. REBILL. Some concerns purchase accessory parts or other material for customers or employees. When the vendor's invoice for this material arrives, it is entered in the purchase analysis like all other bills but the amount of same is posted in the "Rebill" column. The journal entry at the end of the month will be as follows:

*Debit:* Accounts Payable .....\$——

*Credit:* Rebill Account .....\$——

The company pays the bill in the usual manner and then rebills the customer or employee through the accounts receivable section.

ACCOUNT 33. INTEREST EARNED. This account represents the amount of interest earned on notes receivable, etc., for the period. The customer sends in his check for the amount of his promissory note plus the interest incurred. The following journal entry will cover the transaction. Debit "Cash in Bank" with the amount of the note, plus interest and credit "Notes Receivable" with the value of the note only, and the Interest Earned account with the amount of the interest.

ACCOUNT 34. LABOR ACCRUED. This account represents the total amount which is owed to employees for work performed but not paid to them at the end of the month. (For further explanation see Account 31, Accruals.)

The journal entries are as follows:

(1)

<i>Debit:</i> Accounts Payable (with the amount of the payroll for the period) .....	\$_____
<i>Credit:</i> Labor Accrued .....	\$_____

(2)

<i>Debit:</i> Labor Account (with the actual amount drawn from the bank and paid to employees) .....	\$_____
<i>Credit:</i> Cash in Bank .....	\$_____

ACCOUNT 35. SALES. This account represents the amount of net sales for the month, or accounting period. The credit side of the account represents gross sales as explained under Accounts Receivable, Account 3; the sales invoices are distributed on the sales analysis sheets. These sheets when summarized form the basis for making out journal entries for sales:

(1)

<i>Debit:</i> Accounts Receivable (for the amount of the gross sales) .....	\$_____
<i>Credit:</i> Sales .....	\$_____

(2)

<i>Debit:</i> Sales (with the amount of goods returned) .....	\$_____
<i>Credit:</i> Accounts Receivable .....	\$_____

ACCOUNT 36. COST OF SALES. This account represents the cost of the merchandise sold. Like the sales analysis, (see Figure 44) sheets are made up with similar headings to which are posted the costs of the various items sold. This sheet is known as "The Cost of Finished Stock Transfer" and is made up by the cost department. The shipping department draws the required finished goods to satisfy the customers' order from the storesroom on a properly authorized requisition. These requisitions when costed form the basis for compiling the "cost of finished stock transfer" sheets. These sheets are summarized at the end of the month or accounting period and journalized as follows:

*Debit:* Cost of Sales .....\$———  
*Credit:* Finished Stock ..... \$———

ACCOUNT 37. RESERVES FOR INCOME TAX. Like all other accruals, an amount must be set aside to take care of the tax levied by the Federal government on earnings.

ACCOUNT 38. CAPITAL STOCK. This account represents the amount of capital with which the company started business, and for which capital stock is authorized and issued.

ACCOUNT 39. SURPLUS. This account represents the undistributed net profits of the company that are available for dividends.

ACCOUNT 40. NET PROFIT AND LOSS. This account is a clearing account for determining the profit or loss from operations. No balance should appear in it as it is cleared to the surplus account.

With the foregoing explanation of the several accounts on the general ledger, the next step is to compile the profit and loss statement showing the net earnings for the month of January, but before this can be accomplished it is necessary to make several adjusting journal entries which are as follows:

## (1)

<i>Debit:</i> Sales Expense .....	\$	1,345.00	
<i>Credit:</i> Doubtful Accounts Written Off .....			\$ 1,345.00

To charge sales expense with the amount of doubtful accounts written off for the month of January.

## (2)

<i>Debit:</i> Manufacturing Expense .....	\$	713.50	
<i>Credit:</i> Depreciation of Buildings .....			\$ 158.00
Depreciation of Machinery and Equipment .....			487.00
Depreciation of Furniture and Fixtures .....			68.50

To charge manufacturing expense with

the amount of depreciation of Buildings, Machinery and Equipment, and Furniture & Fixtures for the month of January.

(3)

<i>Debit:</i> Cost of Sales .....	\$ 100,603.50	
<i>Credit:</i> Manufacturing Expense .		\$ 1,763.50
Sales Expense .....		61,445.00
Advertising Expense ....		17,520.00
Administrative Expense .		19,875.00
To charge Cost of Sales with the unabsorbed manufacturing Expense, Sales, Advertising and Administrative Expenses incurred during the month of January.		

(4)

<i>Debit:</i> Interest Earned .....	\$ 100.00	
<i>Credit:</i> Profit and Loss .....		\$ 100.00
To credit Profit and Loss with the amount of interest earned during the month of January.		

(5)

<i>Debit:</i> Sales .....	\$1,056,400.00	
<i>Credit:</i> Profit and Loss .....		\$1,056,400.00
To credit Profit and Loss with the net sales for the month of January.		

(6)

<i>Debit:</i> Profit and Loss .....	\$ 777,423.50	
<i>Credit:</i> Cost of Sales .....		\$ 777,423.50
To credit Profit and Loss with the cost of sales for the month of January.		

(7)

<i>Debit:</i> Profit and Loss .....	\$ 34,884.56	
<i>Credit:</i> Reserve for Income Tax .		\$ 34,884.56
To set up a reserve of 12½% of the		

ACCOUNT NO.9					MANUFACTURING EXPENSE				
DATE	J.E. NO.	NAME	✓	DEBIT	BALANCE	DATE	J.E. NO.	NAME	✓ CREDIT
Jan. 31		Balance Fwd.	✓	1 050 00	1 050 00	Jan. 31	3	Cost of Sales	✓ 1 763 50
	2	Depreciation of Bldgs.	✓	158 00					
	2	" Mach. & Eq.	✓	487 00					
	2	" Fur. & Fix.	✓	68 50					
				1 763 50	- 0 -				1 763 50
ACCOUNT NO. 26					SALES EXPENSE				
DATE	J.E. NO.	NAME	✓	DEBIT	BALANCE	DATE	J.E. NO.	NAME	✓ CREDIT
Jan. 31		Balance Fwd.	✓	60 100 00	60 100 00	Jan. 31	3	Cost of Sales	✓ 61 445 00
"	1	Doubtful Accts.	✓	1 345 00					
				61 445 00	- 0 -				61 445 00
ACCOUNT NO. 36					COST OF SALES				
DATE	J.E. NO.	NAME	✓	DEBIT	BALANCE	DATE	J.E. NO.	NAME	✓ CREDIT
Jun. 31		Balance Fwd.	✓	676 820 00	676 820 00	Jun. 31	6	Profit & Loss	✓ 777 423 50
	3	Unabsorbed Mfg. Exp.	✓	1 763 50					
	3	Sales Exp.	✓	61 445 00					
	3	Adv. Exp.	✓	17 520 00					
	3	Adm. Exp.	✓	19 875 00					
				777 423 50	- 0 -				777 423 50
ACCOUNT NO. 40					PROFIT & LOSS				
DATE	J.E. NO.	NAME	✓	DEBIT	BALANCE	DATE	J.E. NO.	NAME	✓ CREDIT
Jan. 31	6	Cost of Sales	✓	777 423 50		Jun. 31	4	Interest Earned	✓ 100 00
	7	Reserve for Income Tax	✓	34 884 56			5	Sales	✓ 1 036 400 00
	8	Surplus	✓	244 191 94					
				1 036 500 00	- 0 -				1 036 500 00

Figure 46. Effect of Accounts from the General Ledger

net income to cover the possible tax on income during the month of January.

(8)

*Debit:* Profit and Loss ..... \$ 244,191.94

*Credit:* Surplus ..... \$ 244,191.94

To credit Surplus with the net Profit for the month of January.

Four accounts have been selected from the general ledger to show the more modern method of posting journal entries. Ledger sheets are so designed that there are three money columns: Debit, Balance, and Credit; the difference between the debit and credit columns is placed in the balance column (see Figure 46); if the balance is a credit in a debit account, a circle is placed around the figure which denotes a credit.

As soon as the adjusting and closing entries have been made and the general ledger balanced, a Statement of Income and Profit and Loss is compiled (Figure 47) and the balance sheet (Figure 48).

# GLOMAZE COMPANY, INC.

## STATEMENT OF INCOME AND PROFIT AND LOSS

For the month ended January 31, 193—

Gross Sales .....	\$1,158,755.00	
Less Sales Returns .....	<u>102,355.00</u>	
Net Sales .....		\$1,056,400.00
Cost of Sales .....	738,507.00	
Less Sales Returns .....	<u>61,687.00</u>	
		<u>676,820.00</u>
Gross Profit from Sales .....		379,580.00
Expense Statement:		
Unabsorbed Manufacturing Expense .....	1,763.50	
Sales Expense .....	61,445.00	
Advertising Expense .....	17,520.00	
Administrative Expense .....	<u>19,875.00</u>	
		100,603.50
Net Profit from Sales .....		<u>278,976.50</u>
Other Income .....		100.00
Net Profit from Operations .....		<u>279,076.50</u>
Reserve for Income Tax .....		34,884.56
Surplus .....		<u>\$ 244,191.94</u>

Figure 47. Statement of Income and Profit and Loss



## GLOMAZE COMPANY, INC.

## BALANCE SHEET—January 31, 1937

## ASSETS

## CURRENT:

Cash in Bank .....	\$ 30,000.00	
Cash on Hand .....	1,000.00	
Notes Receivable .....	15,000.00	
Accounts Receivable .....	\$ 252,839.20	
Less: Reserve for Doubtful Accounts ...	<u>18,460.00</u>	234,379.20

## INVENTORIES (Jan. 31):

Raw Materials and Supplies .....	174,100.00	
Work in Process .....	205,500.00	
Finished Stock .....	175,000.00	
Consignments .....	\$5,500.00	
Less: Consignment Reserve ...	<u>2,000.00</u>	<u>3,500.00</u>

Total Inventories .....	558,100.00	
Investments (at cost) .....	50,000.00	

Total Current Assets .....	<u>888,479.20</u>	
----------------------------	-------------------	--

PREPAYMENTS .....	800.00	
-------------------	--------	--

## FIXED:

Land .....	32,500.00	
Buildings .....	65,000.00	
Less: Reserve for Depreciation ..	<u>15,500.00</u>	49,500.00
Machinery and Equipment .....	40,000.00	
Less: Reserve for Depreciation ..	<u>12,780.00</u>	27,220.00
Furniture and Fixtures .....	5,760.00	
Less: Reserve for Depreciation ..	<u>2,950.00</u>	<u>2,810.00</u>
Total Fixed Assets .....		112,030.00
Total Assets .....		<u><u>1,001,309.20</u></u>

## LIABILITIES

## CURRENT:

Notes Payable .....	27,600.00	
Accounts Payable .....	45,515.00	
Accruals: Taxes and Royalties .....	1,240.00	
Labor .....	3,700.00	
Reserves: Income Taxes .....	67,562.26	
Contingency Reserve for Sales .....	<u>10,500.00</u>	
Total Liabilities .....		156,117.26

## NET WORTH

Common Stock .....	600,000.00	
Surplus .....	<u>245,191.94</u>	
Total Net Worth .....		845,191.94
Total Liabilities and Net Worth .....		<u><u>\$1,001,309.20</u></u>

Figure 48. Balance Sheet

## CHAPTER 30

### COST ACCOUNTING PROCEDURE

**Cost Accounting a Managerial Tool.**—The purpose of business is service, either to a consuming public or other business concerns, and the ultimate objective in the minds of the owners is profit. Needless to say, profit is the margin between the cost and selling price. The economic law of supply and demand may operate to prevent a producer from setting or controlling the price at which his products will sell on the open market. Frequently a manufacturer does base his selling price on cost and neglects to take into account the important economic law of supply and demand. But, sooner or later, he becomes aware that a good cost system is a necessary part of his business and if the selling price is below the cost of production, there is one of two courses open to him, namely, that of closing his plant or finding ways and means of reducing the cost.

Those business men who content themselves with the thought that a cost accounting system is a mere ornament must face a day of reckoning in the near future.

Cost determination is a duty of management, like the sciences, cost accounting has advanced in keeping with technological developments in industry. Cost determination is relatively easy as it depends, more or less, on mathematical calculations, materials, products, specifications, and in many cases a knowledge of engineering drawings.

A good cost system is a valuable tool in the hand of management. It is a yardstick for measuring economy, efficiency, quality, quantity, and accuracy of all operations. This information is of the maximum value in determining managerial policies, planning, and attaining the final objective.

A cost accounting system based upon and developed in the light of executive requirements for specific and accurate data

of unit and departmental costs should aid management in the following ways:

1. To determine economy and efficiency of operations of each activity.
2. To determine the effectiveness of personnel, policies, and equipment.
3. To determine the specific cost of each unit of product.
4. To determine the specific cost of operating each department or other physical unit of activity.
5. To determine inventory investment at all times.
6. To determine periodical variations in all costs.
7. To determine waste and spoilage.
8. To determine equitable wage rates.
9. To secure profitable distribution of sales.
10. To determine the profitable and unprofitable products, machines, operations, departments, supervisors, and customers.
11. To determine advertising appropriations, sales discounts, commission rates, and bonuses.
12. To prepare the financial statement.
13. To determine profit or loss.
14. To formulate the budget.
15. To formulate managerial policies.

**The Fundamental Principles of Scientific Cost Accounting.**—The increased size of modern industrial plants; the mechanized forces utilized to produce their commodities; the complexity of their processes; the technological developments in industry itself; the present day keen competition found in business; these conditions have practically forced management to establish and maintain an adequate system of scientific cost accounting as a mechanism of managerial control. But a cost system based on scientific synthesis, in itself, is not sufficient to cope with the multiplicity of activities in this age of technological production. There must be also a system of scientific analysis of the cost of each element of material and activity so that management may keep its fingers on the pulse of all business functions within its jurisdiction. It must be impressed

again upon the student of business that cost accounting is not a companion science to business management. It is a useful and powerful scientific tool in the hand of an efficient management.

**Basic Laws of Scientific Cost Determination.<sup>1</sup>—**The fundamental laws of scientific cost determination are:

1. The absolute cost of any unit of product, or service, is the sum of all expenditures involved in producing and selling that product, or rendering that service.
2. All cost data should be accumulated through an adequate procedure of scientific synthesis, based upon accurate recorded experience.
3. The unit cost of a product decreases as quantity increases to the point where the law of diminishing returns takes effect.
4. Each item of cost must be beneficial to the product or service.
5. Each item of expense must be measurable by a definite unit and distributed to the cost of the product in the same ratio as the relative benefits are derived from the expenditure.
6. Items of cost of two or more operations, processes, or cost centers may be united for the purpose of determining average unit cost only when the products, operations, and expenses are similar.
7. All cost records must be so established and maintained to permit thorough analysis of each and every part, product, and activity.
8. Waste, scrap, spoilage, shrinkage, and losses are legitimate items of either direct or indirect cost, but income derived from the sale of scrap, where the definite units can be identified as part of the product is a legitimate deduction from the cost of that product.
9. So-called actual costs must be compared with the estimated costs which are based on engineering specifications, material at market price, and labor at current labor rates.

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<sup>1</sup> Dictionary definition of a scientific law:—A statement of an order or relation of phenomena invariable under the given conditions.

10. Inventories should be held at cost or market, whichever is lower.

The above laws represent a practical basis for scientific cost determination. Executives who have utilized them in their businesses, manufacturing, or otherwise, have been highly gratified at the results obtained.

**The Elements of Cost.**—Cost is the amount of money expended to render a service or produce a commodity and place it in the hand of the consumer. The total cost of any article is segregated into three main classifications: first, factory cost; second, sales cost; and third, administrative cost. Factory cost consists of three main elements, namely, (1) material, (2) labor, and (3) factory expense. Sales cost consists of expenditures necessary to place the commodity in the hands of the customer. Administrative expense includes the expenditures involved in managing the organization. From these basic elements of cost, certain valuable cost formulae are derived:

Direct Material + Direct Labor = Prime Cost

Prime Cost + Manufacturing Expense = Factory Cost

Sales Expense + Advertising + Shipping Expense + Warehousing = Cost to Sell

Prime Cost + Cost to Sell + Administrative Cost = Total Cost of Sales

Total Cost of Sales + Profit (or Loss) = Selling Price

**Direct Material Costs.**—This represents the cost of all materials which are known definitely to be utilized or consumed in producing and becoming part of a finished product. It includes that portion of the materials which may be wasted (such as turnings, chips, and ends) during the course of production. Direct materials are sometimes described as those materials whose cost can be accurately measured and allocated to a unit of product or a specific job. In operating practice it is very difficult sometimes to distinguish the direct materials from those materials which are necessary to the manufacture of a product, and in some instances the cost of making this distinction is so great that it is of no practical value at all. The

indirect or accessory materials are legitimately considered as a part of manufacturing expense.

A number of the large industrial concerns increase the cost of raw materials to include the cost of incoming transportation, cost of purchasing, receiving, storing, handling, and other factors involved in actually placing the materials in the stores awaiting the processes of production. However, it seems that these additional activities of service to the material are part of expense and should be considered as such. It is obvious that if the cost of materials are increased by the cost to store those materials, then the cost of the material will vary hourly.

**Direct Labor Costs.**—This represents the cost of all labor which is directly engaged in manufacturing a product, or which is directly applicable to an operation, process, or procedure involved in its production. Indirect, or service labor which is accessory to manufacturing operations, is legitimately considered as a part of manufacturing expense. As in the case of direct material, there are instances which direct labor is charged to manufacturing expense because of the difficulty in measuring its value or the cost of properly allocating the charge.

**Manufacturing Expense.**—This is sometimes called overhead expense and often erroneously referred to as burden. In the true sense of the term, manufacturing expense is no more a burden on a plant than direct material and direct labor. Manufacturing expense represents all manufacturing costs other than the cost of productive labor and direct materials. Manufacturing expense consists of three factors, namely, (1) indirect material, which includes all materials except those used as a component part of a product, that is, such items as fuel, lubricating oils, screw cutting compounds, electric light bulbs, brooms and small tools; (2) indirect labor, such labor which cannot be applied directly against the manufacture of the product—salaries and wages of plant superintendent, foremen, storekeeper, shop clerks, truckers, cleaners, etc.; (3) indirect expenses which include items such as heat, light, water, steam, taxes, depreciation, insurance, etc.

The indirect expenses may be subdivided further into two main groups according to their nature, variable expenses and fixed expenses. Variable expenses include those items of expense that fluctuate because of the changing volume of production. In this group is found the cost of power, supervision, inspection, clerks, maintenance, fire protection, etc.; variable expenses fluctuate from period to period, but not in direct ratio to the changing volume of production but in sympathy with it. Fixed expenses include rent, taxes, insurance, and depreciation. These expenses are assumed to be stationary for a period. This is not the case, in fact, but the fluctuations are, for the most part, of a minor character and thus it is not practicable, as a rule, to recognize and account for these small variations.

A detailed classification of manufacturing expense is recorded on page 99.

**Compiling Factory Costs.**—Each item of cost incurred in the manufacture of a product has a definite relationship to the purpose for which it was incurred. It is, therefore, fundamental that costs should be collected, classified, and compiled on the basis of purpose. Thus, all items of productive material costs should be collected and accumulated under the heading of direct material cost. Productive labor costs should be collected according to operation or process and accumulated under the title of direct labor cost, and all expenses accumulated in accordance with their respective purposes.

The initial steps in the scientific compiling of cost data starts with the issuance of a production order by the production control division of the company. A copy of this production order is furnished to the cost accounting division, another copy is forwarded to the shop planning section, and still another copy to the finished stock stores. The cost copy of the production order, calling for a definite number of products, is the basis for the cost accounting division to open an account on its factory work in process ledger, under that particular order number, wherein all costs incurred in the production of the specific number of products called for on the production order will be entered and accumulated.

**Assembling Direct Material Costs.**—Material requisitions are issued by the planning section which authorize the withdrawal of the required materials for the specific production order. These material requisitions, bearing the production order, are costed at the inventory value of the raw material called for and are entered, by the cost clerk, on the work in process ledger account under the raw materials heading. Thus the cost of all direct materials utilized in the manufacture of the required number of products is recorded in the specific account in the work in process ledger.

**Assembling Direct Labor Costs.**—The shop timekeeper, under the line control of the chief cost accountant, issues a time ticket for each worker and each job, showing the order number of the job, the number of parts produced by the operator, the elapsed time, and the amount of money which the worker receives for the particular job. These time tickets are forwarded to the cost clerk who records them on the respective production order in the work in process ledger under the heading of direct or productive labor. In this manner the cost of all productive labor involved in the manufacture of the specific number of ordered products is shown on the appropriate ledger sheet in the column marked Direct Labor.

**Manufacturing Expense Costs.**—From the very nature of this item of cost, it is obvious that it cannot be assigned definitely to any specific production order in a manner similar to that of direct material or direct labor costs. After the called-for number of products have been manufactured and all the charges made to the specific production order, it is then necessary to determine the amount of manufacturing expense which is applicable to the order by one of the accepted methods.

**Determining Unit Cost.**—As soon as all entries for material, labor, and manufacturing expenses have been recorded on the ledger sheet, the respective columns are totaled and each column is divided by the quantity of products manufactured on that specific production order. This calculation will give the direct or productive material cost per unit of product, the productive



labor cost per unit of product, the manufacturing expense cost per unit of product, and the total factory cost per unit of product.

**Methods of Diffusing Manufacturing Expense.**—The theory underlying the distributing, or applying, manufacturing expense to the cost of a product is based on the assumption that a unit of product increases in value in direct relationship to the number and quantity of services involved as it passes through the various stages of manufacture. Thus when material is moved from one machine to another in the process of production, it theoretically increases in value in direct relationship to the cost of moving. Manufacturing expense, as a whole, is definitely a part of factory cost and bears a relationship to the cost of the product on a time, space, volume, or other basis.

Manufacturing expense is distributed to the cost of the product, or the cost of operating an activity, on an equitable, predetermined basis; or by the utilization of one of the following methods: (See page 118.)

1. Direct Material Cost Method, which assumes a specific relationship between the cost of raw materials and manufacturing expense.
2. Direct Labor Cost Method, which assumes a direct relationship between the cost of productive labor, and the manufacturing expense incurred.
3. Direct Labor Hour Method, which assumes that manufacturing expense is incurred in direct relationship to the passage of time.
4. Machine Hour Method, which assumes that all manufacturing expense is incurred in direct ratio to the number of machine hours of operation.
5. The Specific Volume Method, which assumes that manufacturing expense is incurred in direct ratio to the volume of production.
6. The Specific Space Method, which assumes that manufacturing expense is incurred in direct relationship to the space occupied.

Each of these plans has a specific use. Because of the large increase in mechanization of present day industry and definite ways and means of measuring each expenditure, it is desirable to establish exact ratios of the utilization of each item of manufacturing expense and to apply it to the cost of each product on the basis of that ratio. Process unit manufacturing expense rates should be established on the basis of these ratios for each particular expense item.

**Items of Manufacturing Expense.**—Manufacturing expense is composed of many and varied items, all of which are absolutely essential to the manufacturing operations and therefore must be included in the cost of the various products. This expense is divided into two main classifications: (1) variable expenses and (2) fixed expenses. A detailed list of these expenses is recorded on page 99.

*Variable Expense*

Supervision  
Inspection  
Clerks  
Watchmen  
Machine maintenance  
Lubricants  
Perishable small tools  
Office supplies  
Power  
Freight, express and cartage

*Fixed Expense*

Rent  
Taxes  
Insurance  
Depreciation

**Interest on Investment.**—The question of whether or not interest on investment is a legitimate charge to the cost of production is most controversial. Many concerns include it in their costs while others absolutely oppose such a policy.

The income, or earnings, from business operations is made up of two factors; first, the earning power of the invested capital and second, the additional reward for risking the capital investment. Thus the first factor of income is nominally the interest on the invested capital and it is returned to the investor in the form of profit. Certain investments are considered gilt-edged and yield a moderate rate of interest but it is a general

law of investment that the greater the risk involved, the greater the amount of interest paid for risking the capital.

If it is assumed that interest on investment is charged to the cost of production then the contra entry is recorded as a credit to the profit and loss account. This means that a profit is established before a sale is actually consummated and the value of inventories is naturally greatly inflated.

The authors are therefore opposed to the policy of including the interest on invested capital as a part of cost.

**By-Products Costs.**—A by-product is a secondary product, created at some point during the process of manufacturing the main product. Thus, by-product and main product have a common cost up to the point where separation takes place. Some cost accountants consider that all cost should be borne by the main product, while others endeavor to apportion the costs between the two products.

The common method of handling by-product costs is to apportion all costs to the various products on the basis of their relative market value.



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